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INTRODUCTION

In a report published in 1928 on the deep-sea material of the order Iniomi obtained by the third oceanographic expedition of the *Pawnee*, under the direction of Harry Payne Bingham,[1] the author has endeavored to arrange all previously described species into complete analytical keys to the various families of which representatives were found in the investigated collections. For this purpose the available published descriptions had to be entirely relied upon for the taxonomic definition of the various forms included in the synoptic reviews, except in the cases where the single species were also represented in the Bingham Oceanographic Collection; criticism being otherwise only applied when obvious discrepancies were found to exist in the literature. In the case of the subfamily Myctophinae the earlier descriptions have, however, often proved to be rather inadequate and sometimes also inaccurate or even directly misleading. This holds particularly good of the descriptions rendered before the modern method of describing and classifying the fishes in question, first introduced by Lütken (1892), had won general recognition through the publication of Brauer's significant and extensive report on the deep-sea fishes obtained by the "Valdivia" expedition (Brauer 1906). When recently visiting the United States National Museum in connection with the preparation of further reports on the Bingham Oceanographic Collection, the author therefore took advantage of the opportunity to investigate the numerous type specimens of the said subfamily deposited in the former institution; the purpose of the investigation being to verify, supplement, or correct the original and current descriptions of the various species involved. The results of this investigation will be presented on

[1] Bulletin of the Bingham Oceanographic Collection, Yale University, vol. 3, art. 3.

the following pages, and it is hoped by the author that, with these observations supplementing the keys to the genera *Myctophum*, *Lampanyctus*, *Diaphus*, and *Lampadena*, already previously rendered in the above-mentioned report, a not only practical but also reliable foundation shall have been laid down for the future identification of most of the formerly deplorably confused species pertaining to the said four genera, which together constitute the subfamily Myctophinae.

The abbreviations first introduced by Brauer (1906) for the designation of the various groups or series of photophores will be used throughout in the following notes, in accordance with the practice now generally accepted in the modern literature on these

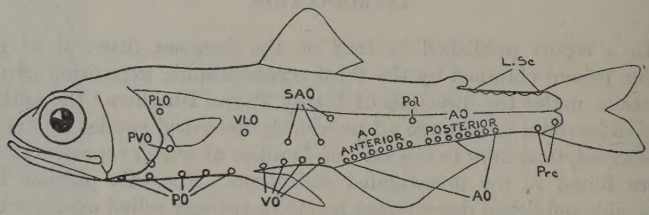

FIGURE 1.—DIAGRAMMATIC DRAWING ILLUSTRATING THE TERMINOLOGY OF THE LUMINOUS ORGANS AS APPLIED TO MYCTOPHUM CALIFORNIENSE (COMPARE WITH FIG. 4). L. SC.=SUPRACAUDAL LUMINOUS SCALES. EXPLANATION OF OTHER LETTERS IN THE TEXT

fishes.[2] The accompanying diagram and list of the abbreviations will sufficiently explain their use and meaning.[3]

PLO=suprapectoral organ.
PVO=subpectoral organs.
PO=thoracic organs.
VLO=supraventral organ.
VO=ventral organs.
SAO=supra-anal organs.
AO=anal organs.
    AO ant.=antero-anal organs.
    AO post.=postero-anal organs.
Pol=postero-lateral organ(s).
Prc=praecaudal organs.

The synoptic reviews of the four genera in question, given in the above-mentioned report upon the Bingham Oceanographic Collec-

[2] Zugmayer 1911, Taaning 1918 and 1928, Barnard 1925, Parr 1928, and others.

[3] The fact that the abbreviations do not always correspond to the full terms employed in the different languages has been intentionally disregarded in the literature for the advantage of obtaining fixed international designations for the organs in question.

tion, will be referred to in the following as "the previously rendered keys." The same arrangement of the species will be used.

SYNOPSIS OF CONTENTS AND CONCLUSIONS

1. Partial or complete redescriptions, with diagrammatic illustrations are rendered of the following distinct species, which have heretofore remained inadequately or incorrectly defined in the literature:

Myctophum crenulare Jordan and Gilbert.
Lampanyctus güntheri Goode and Bean.
Lampanyctus mexicanus Gilbert.
Lampanyctus nannochir Gilbert.[4]
Lampanyctus alatus Goode and Bean.
Diaphus urolampus Gilbert and Cramer.
Diaphus rafinesquei Cocco.[5]
Diaphus chrysorhynchus Gilbert and Cramer.
Diaphus watasei Jordan and Starks.
Diaphus effulgens Goode and Bean.

2. In addition to the above, diagrammatic figures are rendered of the following, not formerly illustrated species:

Myctophum californiense Eigenmann and Eigenmann.
Myctophum imitator Parr (=*M. suborabitale* Gilbert).
Lampanyctus microchir Gilbert.
Lampanyctus punctatissimus Gilbert.
Lampanyctus regalis Gilbert.
Diaphus nipponensis Gilbert.
Diaphus tanakae Gilbert.

3. The following new species and subspecies are defined:

Myctophum fibulatum proximum.

Lampanyctus taaningi, new name, to designate the form currently identified as *Lampanyctus gemmifer* Goode and Beane, the type of Goode and Bean's nominal species being found to actually represent *Lampanyctus crocodilus* Risso.

4. The following, previously established synonymies have been verified on the type specimens:

Myctophum tenua Eigenmann and Eigenmann, synonym of *M. crenulare* Jordan and Gilbert.

Myctophum gilberti Evermann and Seale, synonym of *M. pterotum* Alcock.

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[4] With footnote discussion of the type specimen of the distinct *L. leucopsarus* Eigenmann and Eigenmann in the Museum of Comparative Zoölogy, Cambridge, Mass.

[5] Represented by the type specimens of *D. theta* Eigenmann and Eigenmann, *D. protoculus* Gilbert, and *D. nanus* Gilbert.

Centrobranchus gracilicaudus Gilbert, synonym of *M. andreae* Lütken.

Rhinoscopelus oceanicus Jordan and Evermann, synonym of *M. affine* Lütken.

Myctophum margaritatum Gilbert, synonym of *M. affine* Lütken.

Myctophum braueri Gilbert, synonym of *M. reinhardti* Lütken.

Myctophum remiger Goode and Bean, synonym of *M. hygomi* Lütken.

Notoscopelus brachychir Eigenmann and Eigenmann, synonym of *Lampanyctus elongatus* Costa.

Notoscopelus quercinus Goode and Bean, synonym of *L. elongatus* Costa.

Lampanyctus lacerta Goode and Bean, synonym of *L. duméril*i Bleeker.

Myctophum protoculus Gilbert, synonym of *Diaphus rafinesquei* Cocco.

Diaphus nanus Gilbert, synonym of *D. rafinesquei* Cocco.

5. The status of the following specific designations as synonyms of previously described species can be established for the first time:

Myctophum townsendi Eigenmann and Eigenmann, synonym of *Lampanyctus warmingi* Lütken.

Lampanyctus gemmifer Goode and Bean, synonym of *L. Crocodilus* Risso.

Diaphus theta Eigenmann and Eigenmann, synonym of *Diaphus rafinesquei* Cocco.

6. Due to incorrect original descriptions or figures the following species were found to have been recently redescribed under new names, which must now be included in their synonymies:

Lampanyctus güntheri Goode and Bean redescribed as *L. melanothoraæ* by Parr 1928.

Lampanyctus alatus Goode and Bean redescribed by *L. pseudoalatus* by Taaning 1928.

7. For similar reasons the type specimen of *Lampanyctus gemmifer* Goode and Beane proved entirely foreign to the species currently identified by this name, and for which the new specific name of *Lampanyctus taaningi* is therefore introduced, while *L. gemmifer* Goode and Bean must be placed among the synonyms of *L. crocodilus* Risso.

8. The following species, currently regarded as synonymous with other forms of earlier description, could be reestablished as distinct from the latter:

Lampanyctus macdonaldi Goode and Bean.

Lampanyctus alatus Goode and Bean.

Diaphus watasei Jordan and Starks.

9. The taxonomic status of *Myctophum andreae* Lütken and *Lampanyctus ritteri* Gilbert, Fowler's records of *Myctophum affine* from Hawaii (Fowler 1928, p. 69), the variations of *Diaphus rafinesquei* Cocco, and other items of minor importance are discussed.

10. The original or current definitions are verified without further discussion on all type specimens deposited in the United States National Museum, representing species of the subfamily Myctophinae not specially mentioned in any of the above lists.

MYCTOPHUM CRENULARE Jordan and Gilbert, 1883

Tarletonbeania crenularis GILBERT, 1915.
Myctophum crenulare PARR, 1928 (gives full synonymy).
Tarletonbeania tenua EIGENMANN and EIGENMANN, 1891.

Material investigated. Type specimen of *Myctophum crenulare* Jordan and Gilbert, No. 27402 U.S.N.M., Santa Barbara, California. Type specimen of *Tarletonbeania tenua* Eigenmann and Eigenmann, No. 42882, U.S.N.M., Coronados, California.

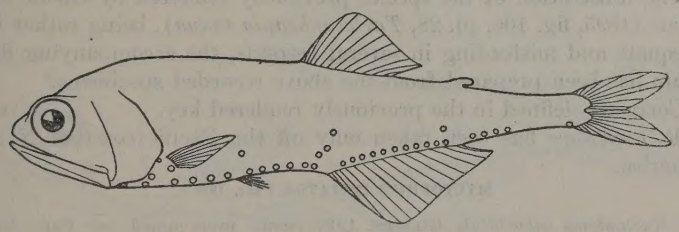

FIGURE 2.—MYCTOPHUM CRENULARE JORDAN AND GILBERT

A very adequate description of *M. crenulare* is rendered by Gilbert 1915 (p. 313), who first established the identity of the two above-mentioned nominal species.

M. crenulare differs from all other species of the genus *Myctophum* by the presence of only one *Prc* and by the absence of pores from all of the lateral line scales except a few of the most anterior ones. It is further characterized by the strong compression of head and body, by the slenderness of the caudal peduncle, and by the nearly rudimentary state of the ventral fins, while the pectorals are well developed.

The type specimen of *Tarletonbeania tenua* shows no significant differences at all from the type of *M. crenulare*, Gilbert's opinion upon the identity of the two has therefore been fully accepted by the author.

The various body proportions of the species are also very characteristic, and rather different from the usual proportions of the genus

Myctophum, particularly with regard to the distances from the snout to the ventral and vertical fins, as will appear from the following table of measurements:

Measurements of M. crenulare Jordan and Gilbert

[In per cent of the total length without caudal fin]

Type of	*Tenua*	*Crenulare*
Total length without caudal fin in mm	61	46
Length of head	26	26.0
Diameter of eye	8	7.6
Greatest height	21	24.0
Length of lower jaw	18	18.5
Height of caudal peduncle	5	5.5
Snout to D	51	50.0
Snout to V	39	39.0
Snout to A	56	54.0

The illustration of the species previously rendered by Goode and Bean (1895, fig. 105, pl. 28, *Tarletonbeania tenua*), being rather inadequate and misleading in several respects, the accompanying diagram has been prepared from the above recorded specimens.[6]

Correctly defined in the previously rendered key.

M. crenulare has been taken only off the Pacific coast of North America.

MYCTOPHUM IMITATOR Parr, 1928

Myctophum suborbitale GILBERT, 1913 (name preoccupied, see Parr, 1928, p. 60).

Myctophum simile TAANING, 1928.

Material investigated. Type specimen of *Myctophum suborbitale* Gilbert, No. 74473, U.S.N.M. Suruga Bay, Japan.

The predorsal length of the type specimen is recorded by Gilbert 1913 as 55 per cent of the total length without caudal fin, but was found by the author to be only 45 per cent of the said measurement, the discrepancy probably being due to a misprint in Gilbert's report. The length of the head was likewise found to be probably more nearly 32 per cent of the total length without caudal fin, than 35 per cent as recorded by Gilbert. The distance from snout to ventral fins equals about 41 per cent of the same measurement.

No illustration of the species having previously been rendered the accompanying diagram was prepared from the type specimen.

Correctly defined in the previously rendered key.

Known only from the coast of Japan.

[6] The figure represents a composite diagram, photophores which have become accidentally lost on the left side shown of the type of *M. crenulare*, on which the drawing is primarily based, have been entered by comparison with the right side and with the type of *Tarletonbeania tenua*.

The type of *M. imitator* (suborbitale) is in every respect perfectly concordant with the brief preliminary diagnosis of *M. simile* rendered by Taaning, 1928 (p. 56), and, if the identity of the two should become definitely established by further investigation of the latter form, Taaning's name would have priority over the name of *M. imitator*.

MYCTOPHUM PTEROTUM Alcock, 1891

Scopelus (*Myctophum*) *pterotus* ALCOCK, 1891.
Myctophum pterotum FOWLER, 1928; PARR, 1928 (full discussion of earlier synonymy).
Myctophum gilberti EVERMANN and SEALE 1907.

Material investigated. Type specimen of *Mycotophum gilberti* Evermann and Seale, No. 55900, U.S.N.M. Philippine Islands.

The identity of *M. gilberti* with *M. pterotum* Alcock, already suggested by Gilbert, 1913 (p. 81), could only be confirmed by an inspection of the type specimen of the former species.

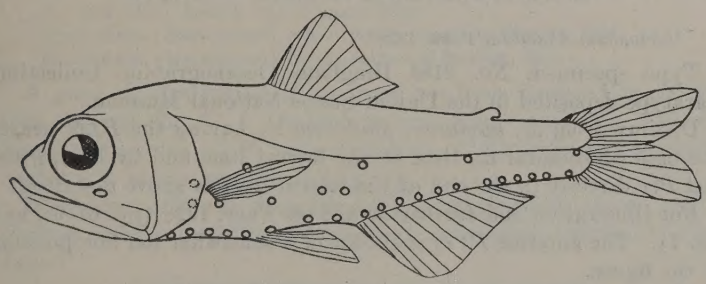

FIGURE 3.—MYCTOPHUM IMITATOR PARR (=M. SUBORBITALE GILBERT)

MYCTOPHUM FIBULATUM Gilbert and Cramer, 1897

Myctophum fibulatum PARR, 1928 (with full discussion of earlier snyonymy, p. 67).

Material investigated. Type specimen No. 47711, U.S.N.M. Hawaii.

A fairly accurate illustration of the type of this species has been rendered with the original description (Gilbert and Cramer, 1897 p. 411, and pl. 38, fig. 2 [7]), and the species has been further discussed in considerable detail by Gilbert 1913 (p. 81, under the heading of *M. pterotum* Alcock).

The type specimen differs somewhat from the specimens previously described and figured by the author (Parr, 1928, p. 67 and fig. 7) in having the *PLO* very close to the lateral line, and by having the last *Pre* immediately below, not directly in the end of the lateral

[7] The legend (pl. 38, fig. 1) erroneously refers this figure to *Diaphus chrysorhynchus*, which is shown in figure 3 on the same plate and is referred to the above-discussed species.

line; while in the material obtained by the Bingham Oceanographic Expedition to the Bahamas, 1927, the *PLO* is considerably closer to the base of pectoral fin than to the lateral line, and the last *Prc* is always directly in the end of the lateral line. In the author's opinion these differences are not sufficiently significant to justify the introduction of an entirely separate species but a subspecific designation of the Atlantic form seems desirable.

The two *PVO* are in both forms arranged in an only very slightly inclined, nearly horizontal series.

Fowler, 1928 (p. 70) still includes *M. fibulatum* among the synonyms of *M. pterotum* Alcock, without giving any reasons for not accepting the arguments rendered by Gilbert 1913 (p. 81) for the distinctness of these two species.

M. fibulatum fibulatum has only been recorded with reliable identification from Hawaiian waters.

MYCTOPHUM FIBULATUM PROXIMUM, new subspecies

Myctophum fibulatum Parr, 1928.

Type specimen, No. 2184 Bingham Oceanographic Collection. Paratype deposited in the United States National Museum.

Distinct from *M. fibulatum fibulatum* by having the *PLO* nearer the base of pectoral fin than to the lateral line, and by having the last *Prc* directly in the end of the lateral line, as above described.

For illustration and further details see Parr, 1928 (pp. 67–69, and fig. 7). The anterior *PVO* is shown in a somewhat too low position in the figure.

Known only from the Tongue of the Ocean, Bahamas.

The species *M. fibulatum* as a whole has been correctly defined in the previously rendered key.

MYCTOPHUM ANDREAE Lütken, 1892

Scopelus (*Rhinoscopelus*) *andreae* Lütken, 1892.
Rhinoscopelus andreae Goode and Bean, 1895; Jordan and Evermann, 1896.
Myctophum coccoi andreae Brauer, 1904.
Myctophum andreae Brauer, 1906, Zugmayer, 1911.
Centrobranchus andreae Gilbert, 1911; Fowler, 1928.
Centrobranchus gracilicaudus Gilbert, 1905; Jordan and Jordan, 1922.
Myctophum nigro-ocellatum (part) Parr, 1928.

Material investigated. Type specimen of *Centrobranchus gracilicaudus* Gilbert, No. 51518 U.S.N.M. Hawaii.

The type of *Centrobranchus gracilicaudus* is in every respect perfectly concordant with the description and figure of *Myctophum*

andreae rendered by Lütken, 1892 (p. 245,[8]) and the author can therefore see no reason for maintaining the former as a separate species.

In the previously rendered key to the genus *Myctophum* (Parr, 1928, p. 62) *M. andreae* has become identified with *M. nigro-ocellatum* Günther through an unfortunate misinterpretation of a note upon these two species rendered by Taaning 1928 (p. 55), for which the author must apologize. *M. andreae* and *M. nigro-ocellatum* are easily differentiable from each other by the characters mentioned in the following supplementary key.[9]

I. First (lower) SAO above third VO. AO 4–7+8–12 [10] *M. nigro-ocellatum* Günther 1889.

II. First (lower) SAO above fourth VO. AO 6+11. *M. andreae* Lütken 1892.

The synonymy of *M. nigro-ocellatum* should then read:

Scopelus nigro-ocellatus GÜNTHER, 1889.
Myctophum nigro-ocellatum TAANING, 1928; PARR, 1928 (part).
Centrobranchus choerocephalus FOWLER, 1903 and 1928; GILBERT 1905, 1908, and 1913; JORDAN and JORDAN, 1928.
Myctophum (*Myctophum*) *coccoi* forma *regularis* BRAUER, 1904.
Myctophum (*Myctophum*) *choerocephalum* BRAUER, 1906.

A good illustration of *M. andreae* has been rendered by Gilbert 1905 (pl. 69, fig. 2) ("*Centrobranchus gracilicaudus*"), who also shows a specimen of *M. nigro-ocellatum* ("*Centrobranchus choerocephalus*") on the same plate (fig. 1.).

M. andreae is known from the Indian and Atlantic oceans, and, as *Centrobranchus gracilicaudus*, from the Hawaiian waters and from Japan.

MYCTOPHUM PRISTILEPIS Gilbert and Cramer, 1897

Dasyscopelus pristilepis GILBERT and CRAMER, 1897.
Myctophum pristilepis PARR, 1928 (full synonymy).

Material investigated. Type specimen No. 47737, U.S.N.M. From Hawaii.

The original description and figure of this species (Gilbert and Cramer, 1897, p. 412 and pl. 39, fig. 1) has been supplemented by Gilbert, 1906 (p. 259 and pl. 3), with a very accurate illustration and a detailed discussion of its characters, to which the author has nothing to add. The species has been correctly defined in the previously

[8] Lütken's figure shows the *SAO* equally spaced, but this feature probably is due to inaccuracy in the drawing and is not mentioned in the text. In the type of *gracilicaudus* the middle *SAO* is distinctly nearer to the lower than to the upper organ of the same series.

[9] To be used for subdivision of point *gg* in the previously rendered key (Parr, 1928, p. 62).

[10] 5–7+9–12, according to Gilbert, 1905, p. 594 ("*Centrobranchus gracilicaudus*"); 4–5+8–9 according to Taaning, 1928, p. 55.

rendered key. Fowler, 1928 (p. 67), combines this species with *M. asperum* Richardson, with which it is very closely related.

The type was obtained in Hawaiian waters. The typical form has later been recorded from near Mauritius (Gilbert, 1906), and an Atlantic subspecies *obtusirostre* is mentioned by Taaning (1928).

MYCTOPHUM CALIFORNIENSE Eigenmann and Eigenmann, 1889

Myctophum californiense JORDAN and EVERMANN, 1896; GILBERT, 1913; TOWNSEND and NICHOLS, 1925, PARR, 1928.
Myctophum humboldti (part) BRAUER, 1906.

Material investigated. Type specimen No. 41920, U.S.N.M. From San Diego, California.

The original description of *M. californiense* Eigenmann and Eigenmann (1889, p. 124) has been very adequately supplemented by Gilbert, 1913 (p. 78), the accompanying diagram of the type specimen, however, represents the first illustration of the species.

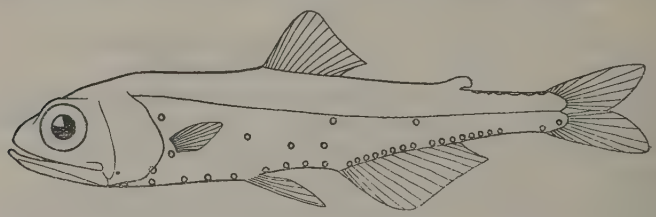

FIGURE 4.—MYCTOPHUM CALIFORNIENSE EIGENMANN AND EIGENMANN

The eyes and the head were found to be slightly larger in the type than in the specimen recorded by Gilbert, equaling 8.5 and 27 per cent, respectively, of the total without caudal fin, instead of 7.8 and 25 per cent of the same measurement.

Correctly defined in the previously rendered key.[11]

Type locality: San Diego, California. Subsequently recorded also from Japan (Gilbert, 1913).

MYCTOPHUM EVERMANNI Gilbert, 1905

Myctophum evermanni BRAUER, 1906; GILBERT, 1908 and 1913; WEBER, 1913, WEBER and BEAUFORT, 1913; JORDAN and JORDAN, 1922; FOWLER, 1928; PARR, 1928.

Material investigated. Type specimen No. 51521, U.S.N.M. From Hawaii.

Adequately described and figured by Gilbert, 1905 (p. 597 and pl. 70, fig. 2).

Correctly defined in the previously rendered key.

[11] For "The last 3–4 posterior *AO* above the base *A*" (Parr. 1928, p. 64, point *Z*), read "The first 3–4 posterior *AO* above the base *A*."

Known from the waters around Hawaii, from the Indo-Australian Archipelago and from Japan.

MYCTOPHUM AFFINE Lütken, 1892

Scopelus affinis LÜTKEN, 1892.
Myctophum affine GOODE and BEAN, 1895; JORDAN and EVERMANN, 1896; BRAUER, 1904 and 1906; LONNBERG, 1905; GILBERT, 1908, 1911, 1913, and 1915; ZUGMAYER, 1911; FOWLER, 1912, not FOWLER, 1928; WEBER, 1913; WEBER and BEAUFORT, 1913; PAPPENHEIM, 1914; JORDAN and JORDAN, 1922; FOWLER and BALL, 1925; TAANING, 1928; PARR, 1928.
Myctophum opalinum GOODE and BEAN, 1895; JORDAN and EVERMANN, 1896, WAITE, 1903; BREDER, 1927.
Myctophum nitidulum GARMAN, 1899.
Rhinoscopelus oceanicus JORDAN and EVERMANN, 1903.
Myctophum margaritatum GILBERT, 1905.

Material investigated. Type specimen of *Rhinoscopelus oceanicus* Jordan and Evermann, 1902, No. 50622, Hawaii. Type specimen of *Myctophum margaritatum* Gilbert, 1905, No. 51536, Hawaii.

An inspection of the above mentioned types can only serve to verify in every respect the identity of these two nominal species with the cosmopolitan *M. affine* Lütken, as already made out by Brauer, 1906 (p. 190) and by Gilbert, 1908 (p. 217) and 1913 (p. 77).

Fowler, 1928 (p. 69), figures a young specimen (of about 30 mm. length without caudal fin),[12] and describes another, of 72 mm. length, referring both to *M. affine*. These specimens do, however, neither seem identical with each other nor can either one of them be identified with Lütken's *M. affine*, unless the description and figure should be very inaccurate and misleading. The illustration shows a specimen with *prominent snout*, *6 PO*, *4 VO*, *SAO* in a straight series, 10+5 *AO*, only one single *Prc*, anal origin under the anterior part of the base of dorsal fin, the ventrals inserted far in advance of the origin of dorsal fin, and no lateral line. If these features are accurately shown in the drawing the specimen certainly must represent an entirely new species most closely related to the group of *M. coccoi* Cocco, *M. nigro-ocellatum* Günther and *M. andreae* Lütken, but has no relationship at all to *M. affine* Lütken. The larger specimen is on the other hand described as having a "very short" snout, only 6+4 *AO*, 2 *Prc*, and a lateral line. That these two specimens can not be identical if figure and description are both reliable, is obvious without further discussion. That the larger specimen can not either be identical with Lütken's *M. affine* is indicated by the following features. The specimen is described as having "4 pectorals"; "2 anterolaterals"; "5 thoracic"; and "ventrals apparently 3." The fact that there are 5 "thoracics" in addition to the 4 "pectorals" shows that there must be one photophore more on the

[12]According to the scale of the illustration, fig. 13, in his Fishes of Oceania.

anterior part of the body than there is in *M. affine* (which has 1 *PLO*+2 *PVO*+5 *PO*=8, only, instead of 9). According to the definition of antero-lateral organs (Goode and Bean, 1895, tentative arrangement of the genera of Myctophidae, with diagram and explanation of terms, inserted between pages 70 and 71, *loc. cit.*), the presence of two such photophores as described by Fowler would mean, in modern terms, that the second *VO* is elevated, a condition which also automatically explains the statement that there are apparently only 3 "ventrals," the second *VO* being counted as an antero-lateral. Fowler's larger specimen, therefore, would probably belong in division *B*, II, *e*, 2, *x* (p. 60) in the previously rendered key to the genus *Myctophum* (Parr, 1928), but does not seem to have any relationship to *M. affine*, in which the 4 *VO* are all situated on the same level.

MYCTOPHUM REINHARDTI Lütken, 1892

Scopelus reinhardti LÜTKEN, 1892.
Myctophum reinhardti PARR, 1928 (with full synonymy).
Myctophum braueri GILBERT, 1905.

Material investigated. Type specimen of *Myctophum braueri* Gilbert, No. 51527 U.S.N.M., from Hawaii.

The identity of *M. braueri* Gilbert 1905 (p. 598 and Plate 70, fig. 1[13]) with Lütken's *M. reinhardti* has already been established by Gilbert, 1908 (p. 219), and can only be confirmed by the author after an inspection of the type-specimen of the former nominal species.

MYCTOPHUM HYGOMI Lütken, 1892

Scopelus hygomi LÜTKEN, 1892.
Myctophum hygomi PARR 1928, (with full synonymy).
Myctophum remiger GOODE and BEAN, 1895.

Material investigated. Type lot of *Myctophum remiger* Goode and Bean 1895, No. 43792, 9 specimens from the western Atlantic.

Inspection of the type specimens of *M. remiger* G. a. B. only serves to verify the identity of this form with Lütken's *M. hygomi* as already made out by Jordan and Evermann, 1986, page 573.

The sample showed the following compositions of organs in the anal series, each side being counted separately. 6+7 *AO* in 4 cases; 7+6 *AO* in 12 cases; and 7+7 *AO* in 2 cases (1 specimen). Asymmetry of the nature $\frac{6+7}{7+6}$ *AO* was found in two specimens.

Known from the Mediterranean, the Atlantic, and the Indian Oceans.

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[13] Misnamed *M. lütkeni* in the legend of the figure (see Gilbert, 1908).

LAMPANYCTUS WARMINGI Lütken, 1892

Scopelus (Nyctophus) warmingi LÜTKEN, 1892*b*.
Lampanyctus warmingi PARR, 1928 (with earlier synonymy).
Myctophum townsendi EIGENMANN and EIGENMANN, 1889.
Lampanyctus townsendi PARR, 1928 (with earlier synonymy); FOWLER, 1928.

Material investigated. Type lot of *Myctophum townsendi* Eigenmann and Eigenmann, 1889, No. 41921, U.S.N.M., from Cortez Banks, California.

The largest specimen of the sample of *Myctophum townsendi*, the only one which is still legible, is in every respect perfectly concordant with the Atlantic specimens of *L. warmingi* Lütken (see Taaning, 1928, p. 65, and Parr, 1928, p. 91), both with regard to proportions, photophores, and luminous scales. The latter are found in the same, characteristic arrangement as in *L. warmingi* in a single mid-ventral series between ventral fins and the vent, ending in a symmetrical pair, one on each side of the anal opening, (see also Gilbert, 1913, p. 99). A group of luminous scales below the throat, now lost in the type, has also been described by Gilbert (1913, p. 99). There is a whitish patch above the eye, preserved in a bad condition, only on one side, which may be an artefact or might possibly represent a luminous tissue, similar to the presumably luminous patches found in the same position in *L. photothorax* Parr, 1928. This feature is, however, of a highly questionable nature and taxonomic value, and the investigated lot shows no adequate reason at all for regarding *L. townsendi* as a distinct species from *L. warmingi*.

LAMPANYCTUS MARGARITIFER Goode and Bean, 1895

Notoscopelus margaritifer GOODE and BEAN, 1895.
Macrostoma margaritiferum JORDAN and EVERMANN, 1896.
Myctophum (Lampanyctus) margaritiferum BRAUER, 1906.
Lampanyctus margaritifer PARR, 1928.

Material investigated. Type specimen No. 43775, U.S.N.M. From the northwestern Atlantic.

The original figure of this species (Goode and Bean, 1895, fig. 98, pl. 26) apparently renders a fairly accurate picture of the arrangement of the photophores, being generally correct in as far as it is now possible to check up on the type-specimen. The only obvious difference worth mentioning is contributed by the fact that 5 *VO* in a straight series are found in the type, while only 4 of these organs are shown in the figure. The upper *PVO* has now become lost on both sides, but is shown above the base of the pectoral fin in Goode and Bean's drawing.

Correctly defined in the previously rendered key.

Known only from the Newfoundland Banks.

LAMPANYCTUS ELONGATUS Costa, 1844

Scopelus elongatus Costa, 1844.
Lampanyctus elongatus Parr, 1928 (with full synonymy).
Notoscopelus brachychir Eigenmann and Eigenmann, 1889.
Catablemmela brachychir Eigenmann and Eigenmann, 1891.
Notoscopelus quercinus Goode and Bean, 1895.
Macrostoma quercinum Jordan and Evermann, 1896.
Myctophum (*Lampanyctus*) *quercinum* Brauer, 1906.

Material investigated. Type specimen of *Notoscopelus brachychir* Eigenmann and Eigenmann, 1889, No. 76336, U.S.N.M. From Cortez Banks, California. Type specimen of *Notoscopelus quercinus* Goode and Bean, 1895, No. 43789, U.S.N.M. From the Newfoundland Banks.

Only a few of the photophores can still be made out with certainty on either of the two above mentioned type specimens, which are in a rather bad condition. There is, however, nothing to refute the view already previously held by the author that *Notoscopelus brachychir* and *quercinus* are both perfectly identical with *Lampanyctus elongatus* Costa, as already made out by Jordan and Evermann, 1896 (p. 556) in the case of the former of the two nominal species.

LAMPANYCTUS CASTANEUS Goode and Bean, 1895

Notoscopelus castaneus Goode and Bean, 1895.
Macrostoma castaneum Jordan and Evermann, 1896.
Myctophum (*Lampanyctus*) *castaneus* Brauer, 1906.
Lampanyctus castaneus Parr, 1928.

Material investigated. Type specimen No. 31706, U.S.N.M. From the northwestern Atlantic.

The condition of the type specimen makes it quite impossible to observe any details of specific significance, practically all of the photophores having now become lost. Nothing can therefore be added to the unfortunately rather inadequate original description, and the accuracy of the details shown in the only illustration of this species (Goode and Bean 1895, fig. 95, pl. 25) can not be determined.

LAMPANYCTUS GÜNTHERI Goode and Bean, 1895

Lampanyctus güntheri Goode and Bean, 1895; Jordan and Evermann, 1896; Waite, 1910 (?); Parr, 1928.
Myctophum (*Lampanyctus*) *güntheri* Brauer, 1906; Pappenheim, 1914.
Lampanyctus melanothorax, Parr, 1928.

Material investigated. Type specimen No. 43777, U.S.N.M. Newfoundland Banks.

It appears from an inspection of the above type specimen that the lateral line scales of *L. güntheri* are very much enlarged indeed, particularly on the posterior part of the body, where their broad posterior (free) margins extend over approximately three-fourths,

or more, of the entire height of the caudal peduncle. The fact that the said species was referred by Goode and Bean, 1895, to the genus *Lampanyctus*, in the restricted sense in which this generic designation was employed by the said authors to embrace only the species which combined among other characters the feature of having the scales of the lateral line "scarcely larger than the others," is therefore inexplicable,[14] and has caused the author previously to redescribe the species under the name of *L. melanothorax*. The specimens reported by Waite, 1910, as having the lateral line scales only scarcely enlarged may possibly pertain to another species, if a similar misleading use of these descriptive terms has not also been made by Waite.

The type specimen of *L. güntheri* is in all other respects quite concordant with the material of *L. melanothorax* Parr previously reported upon (see Parr, 1928, p. 99), as will appear from a comparison of the accompanying diagram of the former with the figure and de-

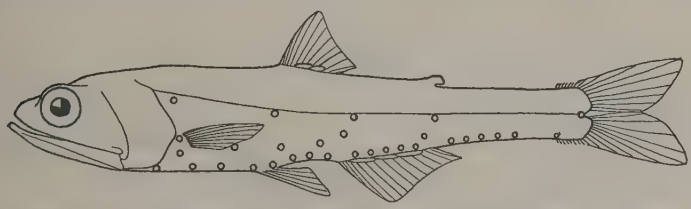

FIGURE 5.—TYPE SPECIMEN OF LAMPANYCTUS GÜNTHERI GOODE AND BEAN. SUPRA- AND INFRA-CAUDAL LUMINOUS SCALES LOST

scription of the latter (*loc. cit.*). Most of the luminous scales, the second and third *Prc*, and possibly the sixth postero-anal organ have become lost, however, in the type of *L. güntheri*, but there is no reason to assume that these organs, when present, would have differed from those of the nominal *L. melanothorax*.

The species has been recorded from Atlantic and Australian waters.

L. gaussi Brauer 1906, which has been identified with *L. güntheri* by Taaning 1928, differs according to Brauer's description in having 6 *VO* and a luminous scale at the base of ventral fin, while only 5 *VO* and no luminous scale in the said position are found in *L. güntheri*.

LAMPANYCTUS MEXICANUS Gilbert, 1891

Myctophum mexicanum GILBERT, 1891.
Nannobrachium mexicanum JORDAN and EVERMANN, 1896.
Myctophum (*Lampanyctus*) *mexicanum* BRAUER, 1906.
Lampanyctus mexicanus PARR, 1928.

Material investigated. Type specimen No. 76343, U.S.N.M. From the Gulf of California.

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[14] The original illustration of the species (Goode and Bean, 1895, fig. 90, pl. 24) is also entirely misleading in this respect.

PLO at the lateral line. First *PVO* well below and anterior to the second *PVO*.[15] 5 *PO*, the fourth elevated approximately to the level of the upper *PVO*. Interspace between first and second *PO* enlarged. *VLO* very low, its distance from the base of ventral fin only about one-third of its distance from the lateral line. 4 *VO*, the second *VO* elevated to the level of the *VLO*. *SAO* broadly angulate. First *SAO* above the interspace between third and fourth *VO*, somewhat nearer to the vertical from the former. Second *SAO* above and behind fourth *VO* and slightly higher than first *SAO*. Third *SAO* at the lateral line, somewhat behind the vertical from second *SAO*. The continuation of the line through second and third *SAO* passes well behind the last *VO*. Only 4 widely spaced antero-anal organs, with the interspaces gradually decreasing caudalwards. None of the antero-anal organs elevated. 2 *Pol*, the upper at the lateral line, well behind the vertical from the lower *Pol*, which is situated well behind and somewhat higher than the last antero-anal organ. The anterior

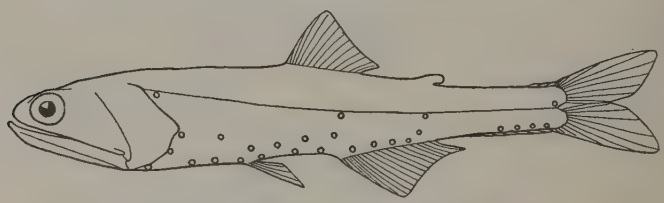

FIGURE 6.—LAMPANYCTUS MEXICANUS GILBERT

organs of the postero-anal series have unfortunately now become lost in the type specimen, but four organs are found on each side on the posterior part of the caudal peduncle in a continuous, horizontal series along the ventral outline of the tail, ending at the bases of the lower caudal rays. These four organs evidently must comprise the posterior postero-anals and the anterior (lower) praecaudals and their arrangement indicates these two series to be perfectly confluent. The ultimate *Prc* is situated close to, but very distinctly above the end of the lateral line. No intermediate organ was found between this upper praecaudal and the above described posterior organ of the ventral series (see figure), but there is a possibility that such organs may originally have been present and have subsequently become lost in the type specimen. This possibility is, however, not confirmed by the original description, according to which there were "six pairs of spots along the under side of tail, and three along base of lower caudal lobe." (Gilbert, 1891, p. 52), when the specimen was

[15] The pectoral fins have practically completely disappeared in this species and their bases can therefore scarcely serve as orientation points for describing the positions of the photophores.

still in a comparatively fresh state of preservation. In modern terms the above quoted description should therefore probably read: Six postero-anals. The three anterior (or lower) *Prc* situated along the base of lower caudal lobe.[16] With further details as above described.

The obscure terminology of the original description has caused the species to be recorded as having 6+6 *AO* (Brauer, 1906, p. 167) or 6+5 *AO* (Parr, 1928, p. 84), the actual numbers being 4+6 (?) *AO*+4 *Prc*, as above made out. Otherwise correctly defined in the previously rendered key.

6–7 infracaudal and 3 supracaudal luminous scales, not elevated on procurrent caudal spines.

The type specimen shows the following proportions in per cent of the total length without caudal fin (44 mm.). Length of head 30. Diameter of eye 6.8. Length of lower jaw 23. Greatest height 18. Distance from snout to dorsal fin 50. Distance from snout to ventral fins 42. Distance from snout to anal fin 60.

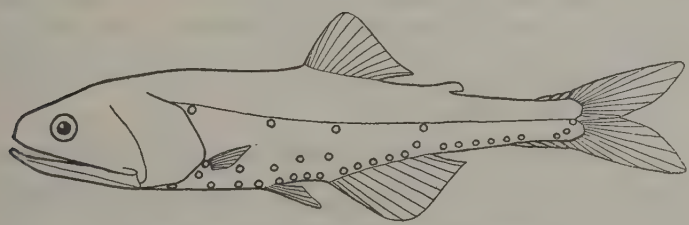

FIGURE 7.—LAMPANYCTUS MICROCHIR GILBERT

The advanced position of the ventrals relative to the dorsal fin, the low position of the *VLO*, the low number of photophores in the antero-anal series and the comparatively few scales are the distinguishing features of the species.

LAMPANYCTUS MICROCHIR Gilbert, 1913

Lampanyctus microchir GILBERT, 1913; PARR, 1928.

Material investigated. Type specimen No. 74468, U.S.N.M. Suruga Bay, Japan.

A fully adequate and very accurate description of this species has already been rendered by Gilbert, 1913 (p. 101), but no illustration has so far been published. The accompanying diagram has therefore been prepared from the type specimen.

Correctly defined in the previously rendered key.

Known only from the type specimen.

[16] The praecaudals being arbitrarily counted as four when they are confluent with the postero-anals (see Parr, 1928, p. 77).

LAMPANYCTUS NANNOCHIR Gilbert, 1891

Myctophum mannochir GILBERT, 1891 (part).

Nannobrachium nannochir (part), JORDAN and EVERMANN, 1896; GILBERT, 1895.

Lampanyctus nannochir GILBERT, 1913, PARR, 1928.

? *Myctophum* (*Lampanyctus*) *leucopsarum* BRAUER, 1906.

Material investigated. Type lot No. 44291, U.S.N.M.[17] 8 specimens from off the coast of the State of Washington.

In spite of the various, quite extensive discussions of its taxonomic status rendered by Gilbert (1895, p. 399; 1913, p. 100, and 1915, p. 315, under *L. leucopsarus*), subsequent to its original description (Gilbert, 1891, p. 51), *L. nannochir* has up to the present date remained a very obscurely and unsatisfactorily defined species. After an inspection of the type sample deposited in the United States National Museum the author is able, however, to verify the specific distinctness of Gilbert's species from the closely related *L. leucopsarus* Eigenmann and Eigenmann[18] as well as from all other forms included in the genus *Lampanyctus*. The following description of the type sample, of which only one specimen is sufficiently well preserved to show the arrangement and numbers of the photophores, may serve for future identification.

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[17] A second type specimen (No. 1459 of the Leland Stanford Junior University Museum, from the same haul as the type-sample in the U.S.N.M.) has also been assigned to the species in a later publication by Gilbert (1895, p. 400), wherein a more restricted definition of *L. nannochir* is rendered. It is obvious, however, that the specimens of *L. leucopsarus*, with which species *L. nannochir* was at first confounded, must have become weeded out of the type sample of the latter species, probably by Gilbert himself, subsequent to the publishing of the original description, as no such specimens are found in the sample to-day.

[18] The author has had opportunity to examine the type of *L. leucopsarus* Eigenmann and Eigenmann in the Museum of Comparative Zoölogy, Cambridge. This specimen differs from the above-discussed type of *L. nannochir* in having the upper *SAO* and *Pol* only about the length of one of their own diameters, or even considerably less (*Pol*), removed from the lateral line; by the presence of 4 *Prc* in an equally curved series, well separated from the postero-anal organs; and by the presence of 5 *VO*, the second being elevated and advanced to a position nearly vertically above the first *VO*. No traces of a *VLO* are found in the type of *L. leucopsarus*, and there seems to be no indication of such organ ever having been present on the specimen. A comparison with the type of *L. nannochir* might further suggest the possibility that the so-called *VLO* of the latter specimen should actually be homologous with the second *VO* of the type of *L. leucopsarus*, this organ having in the former species merely become further elevated and advanced to a position slightly anterior to the vertical from the first *VO*. On the basis of this assumption both species might be defined as having lost their *VLO*. The type of *L. nannochir* must otherwise be defined as distinct from the type of *L. leucopsarus* in having only 4 *VO* as compared to the unquestionable 5 *VO* of the latter, in direct contradiction of the comparative tabulation of the features of these two species given by Gilbert, 1895 (p. 399). Other differences in proportions, etc., claimed by the said author could not be verified on the type specimens, which, on the contrary, seem quite concordant in all measurements. A thorough revision of the various collections referred to each of the respective species is highly desirable to clear the confusion existing in all previous descriptions. The types of both species agree in the practically rectilinear arrangement of the *SAO*, the lower one of which is situated entirely behind the vertical of the last *VO*; and also in having the *Prc* well separated from the postero-anal series.

Total length without caudal fin 97 mim.[19] Proportions in per cent of the total length without caudal fin: Length of head 28. Diameter of eye 6.6. Length of lower jaw 22. Greatest height 19. Distance from snout to dorsal fin 46. Distance from snout to ventrals 40.5. Distance from snout to anal fin 56.

Origin of anal fin below the end of the anterior three-fifths of the base of dorsal fin. The general appearance of the species will be sufficiently evident from the accompanying diagram.

PLO nearer to the lateral line than to the base of pectoral fin. Upper *PVO* vertically above lower *PVO*. 5 *PO*, the fourth elevated to approximately midway between the levels of the upper and the lower *PVO*. The interspace between first and second *PO* enlarged. *VLO*[20] approximately midway between the lateral line and the base of ventral fin, or lower, only slightly in advance of the vertical from

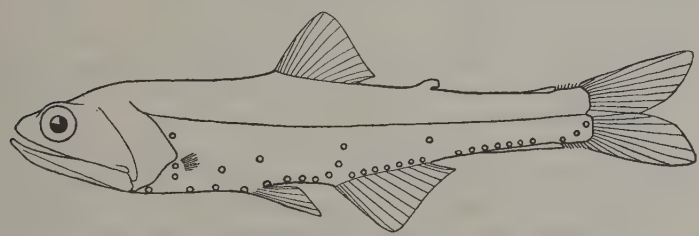

FIGURE 8.—LAMPANYCTUS NANNOCHIR GILBERT

the anterior *VO*. 4 *VO* with gradually decreasing intervals, the first interval being the widest. 3 *SAO* in a very slightly curved, nearly straight, series, with the lower organ well behind and only slightly higher than the fourth *VO*. This lower *SAO* probably represents the fifth *VO* of earlier descriptions. Second *SAO* only slightly nearer to the lower than to the upper *SAO*. Upper *SAO* about 3 of its own diameters below the lateral line canal. 7+7 *AO* (determined by comparison between the different specimens in the type-sample). *Pol* posterior to the vertical from the last antero-anal organ and about 3 of its own diameters below the lateral line canal. The postero-anal series begins at a considerable distance (about equal to two normal photophore-intervals or even more) behind the end of the base of anal fin. 3 *Prc*, well separated from the postero-anal organs and apparently arranged in a nearly straight or only very

[19] The measured specimen, on which the following description and figure are mainly based, carried the tin tags of the sample and probably represents the holotype of the species. Only the numbers and accurate arrangement of the posterior ventral series (*AO* and *Prc*) were determined by comparison with the other specimens.

[20] See footnote 18 on the preceding page.

slightly curved series, with the upper organ somewhat below the end of the lateral line.

The luminous scales are difficult to make out, but it is obvious that the infracaudal scales have occupied considerably more than one-third of the length of the caudal peduncle, as claimed by Gilbert 1895, probably more nearly two-thirds of the same. The supracaudal series, however, has scarcely been more than half the length of the infracaudal series, thus conforming with Gilbert's statement.

The various published records of the species are of highly questionable taxonomic validity.

LAMPANYCTUS MACDONALDI Goode and Bean, 1895

Nannobrachium macdonaldi GOODE and BEAN, 1895; JORDAN and EVERMANN, 1896.

Material investigated. Type specimen No. 39478, U.S.N.M. Northwestern Atlantic.

The above type specimen is in most respects quite concordant with the redescription of Günther's *L. niger*[21] rendered by Brauer, 1906 (p. 242), and differs from the three new species *L. ater*, *L. lineatus* and *L. cuprarius* introduced by Taaning, 1928 in having the *VLO* inserted far below the lateral line. Brauer describes the *VLO* as being situated "ein wenig" (a little, somewhat), below the lateral line in the specimens examined by him, and his figure (1906, fig. 159), shows its distance from the lateral line as only about one-third of its distance from the base of ventral fin. In the type of *L. macdonaldi* the ratio between these two distances equals about 2:3. In *L. macdonaldi* the *PLO* is also inserted approximately midway between the lateral line and the base of pectoral fin, and the two *PVO* are situated nearly vertically above each other; while in Brauer's description and figure of *L. niger* the *PLO* is close to the lateral line and the *PVO* are arranged in a very oblique series with the upper organ well in advance of the lower. For these reasons the author has felt justified in reestablishing *L. macdonaldi* Goode and Bean as a separate species, and the following brief synopsis may serve for its identification, as a supplement to point *zz* (p. 87), in the previously rendered key (Parr, 1928).

v. *VLO* a little or far below the lateral line.

n. *PLO* near the lateral line. *PVO* in an oblique series, with the upper photophore well in advance of the lower. *VLO* much nearer to lateral line than to base of ventral fin.

L. niger (Günther) Brauer, 1906.

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[21] The *L. niger* recorded by Gilbert, 1905 (p. 591) and 1913 (p. 100), obviously is identical with the *L. ater* described by Taaning, 1928, having the *VLO* immediately below the lateral line and the first *SAO* above the interspace between second and third *VO*: but on the other hand is not concordant with the redescription of *L. niger* rendered by Brauer, 1906 (p. 242) [see Parr, 1928, pp. 87 and 104]. Fowler, 1928 (p. 68), merely refers to Gilbert's descriptions.

n³. *PLO* about midway between lateral line and the base of pectoral fin. *PVO* in an approximately vertical series. *VLO* only moderately closer to the lateral line than to the base of ventral fin, the ratio between the two distances being only about 2 : 3.

L. macdonaldi Good and Bean, 1895.

v². *VLO* immediately below the lateral line.

L. ater Taaning, 1928.
L. cuprarius Taaning, 1928.
L. lineatus Taaning, 1928.

The inadequacy of the original figure and description (Goode and Bean, 1895, fig. 110, pl. 29, and p. 94), makes it desirable to refigure and redescribe *L. macdonaldi* in full detail.

Total length of type specimen exclusive of caudal fin 104 mm. Proportions in per cent of the total length without caudal fin: Length of head 29. Diameter of eyes 5.8. Length of lower jaw 23. Greatest height 17. Height of caudal peduncle 10.5. Distance from snout to dorsal fin 46. Distance from snout to ventrals 43. Distance from snout to anal fin 58.

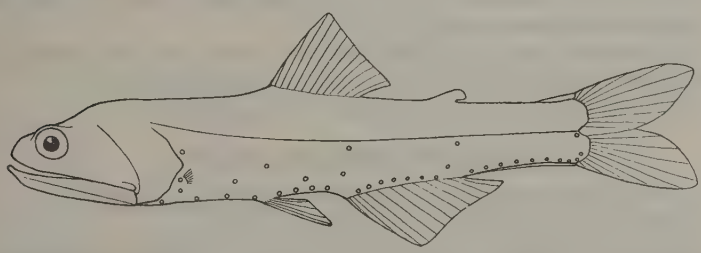

FIGURE 9.—LAMPANYCTUS MACDONALDI GOODE AND BEAN. THE NUMBER OF SEPARATE INFRA- AND SUPRA-CAUDAL LUMINOUS SCALES CAN NOT BE CLEARLY MADE OUT IN THE TYPE SPECIMEN

Snout short. Praeopercular margin strongly inclined. Ventrals somewhat in advance of the origin of dorsal fin. Origin of anal fin under the end of the anterior three-fourths of the base of dorsal fin. The comparatively great height of the caudal peduncle is conspicuous. Pectorals rudimentary.

PLO about midway between lateral line and base of *P*. *PVO* nearly vertically arranged. 5 *PO*, the fourth elevated to midway between the levels of lower and upper *PVO*. *VLO* about two-thirds as distant from the lateral line as from the base of ventral fin. 4 *VO*, all on the same level. 3 *SAO*, broadly angulate. First *SAO* above the interspace between second and third *VO*. Second *SAO* only very slightly higher, well behind the vertical from the last *VO*. Upper *SAO* close to the lateral line, on a line with the second *SAO* which passes well behind the fourth *VO*. 7 antero-anal organs, equally spaced in a gently convex curve, none ele-

vated. 2 *Pol*, the upper close to the lateral line and well behind the vertical from the lower *Pol*, which is again well behind, but not so very much higher than, the last antero-anal organ (see figure). 7 postero-anals, entirely behind the base of anal fin and confluent with the praecaudals, which have been counted as four. Ultimate *Prc* immediately below the end of the lateral line, vertically above or even very slightly in advance of the penultimate *Prc*. Interspace between ultimate and penultimate *Prc* greatly increased.

Supracaudal luminuos plates occupy only about one-third of the distance between adipose and caudal fins, while the infracaudal plates extend through almost the entire length of the caudal peduncle. The numbers of the luminous scales can not be counted.

But for the type specimen there is no reliable record of the species.

LAMPANYCTUS OMOSTIGMA Gilbert, 1908

Lampanyctus amostigma GILBERT, 1908; JORDAN and JORDAN, 1922; PARR, 1928, FOWLER, 1928(?).

Material investigated. Type specimen No. 75769, U.S.N.M. From the Marquesas Island.

Lampanyctus omostigma has been very adequately and accurately described and figured by Gilbert, 1908 (p. 232 and pl. 5).

Correctly defined in the previously rendered key.

LAMPANYCTUS REINHARDTI Jordan, 1922

Nyctimaster reinhardti JORDAN, 1922; JORDAN and JORDAN, 1922.
Lampanyctus omostigma (part ?), Fowler, 1928.

Material investigated. Type lot No. 84095, U.S.N.M. (2 specimens from the coast of Hawaii).

This purely nominal species is entirely without taxonomic value, being quite unidentifiable either from the types or from the original description, on account of the dried out condition of the specimens on which it has been based, and the consequent inadequacy of its diagnosis. It may be taken for granted from their general appearance that the type specimens represent some species of the genus *Lampanyctus*, but nothing is known or perceptible of the numbers and arrangement of their photophores.

Fowler, 1928 (p. 69), provisionally identifies *L. reinhardti* with *L. omostigma*. This view on the taxonomic status of the former nominal species is quite probably correct, but can neither be proved nor disproved on the basis of the above discussed type specimens; and, as the same will also hold good of any other theory that might be advanced, the author has deemed it advisable not to accept or attempt any identification at all.

LAMPANYCTUS PUNCTATISSIMUS Gilbert, 1913

L. punctatissimus GILBERT, 1913; PARR, 1928.

Material investigated. Type specimen No. 74469, U.S.N.M. Suruga Bay, Japan.

Adequately and accurately described by Gilbert, 1913, p. 103, but not formerly illustrated. The accompanying diagram has therefore been prepared from the type specimen.

VLO, upper *SAO*, *Pol* and *Prc* immediately below the lateral line.[22]

Correctly defined in the previously rendered key.

Known only from Japan.

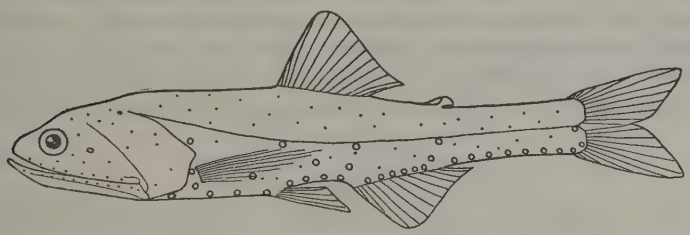

FIGURE 10.—LAMPANYCTUS PUNCTATISSIMUS GILBERT. ONLY A SMALL SELECTION OF THE MINUTE ACCESSORY PHOTOPHORES HAVE BEEN DRAWN TO SHOW THEIR RELATIVE PROPORTIONS

LAMPANYCTUS STILBIUS Gilbert, 1913

Lampanyctus stilbius GILBERT, 1913; PARR, 1928; FOWLER, 1928.

Material investigated. Type specimen. No. 757768, U.S.N.M. Marquesas Island.

Very accurately and adequately described and figured by Gilbert 1908 (p. 235 and pl. 6).

Correctly defined in the previously rendered key.

Recorded only from the type locality.

LAMPANYCTUS RITTERI Gilbert, 1915

Lampanyctus ritteri GILBERT, 1915; PARR, 1928.

Material investigated. Type specimen No. 75807, U.S.N.M. Monterey Bay, California.

Adequately described and figured by Gilbert, 1915 (p. 318 and fig. 3, pl. 15). The presence of a very minute photophore on the shoulder, mentioned by Gilbert, as a small humeral spot, in addition to a similar small photophore above the posterior corner of the mouth identifies this species with division *c* (p. 88), instead of division *d*

[22] "Near the lateral line but not in contact with it."

(p. 89), in the previously rendered key. These spots are, however, both so minute that they will probably not be recognizable in small or even moderate sized specimens, the type specimen being very large, 120 mm. without caudal fin. This particularly holds good of the photophore on the shoulder. The species will therefore probably more often be looked for in the said division *d*, in which it has previously been placed, or even in division *a* (loc. cit., p. 83). In division *c*, *L. ritteri* will be easily recognizable by the low position of its *VLO*, which is only about midway between the lateral line and the base of ventral fin, while it is situated immediately below the lateral line in the three other species of the same division (*L. punctatissimus*, *L. jordani*, and *L. stilbius*). In division, *a*, the species will seem very close to *L. macdonaldi*, as described on the preceding pages, being differentiable, however, by the higher position of its *PLO*, which is much closer to the lateral line than to the base of pectoral fin, instead of midway between as in *L. macdonaldi*, and

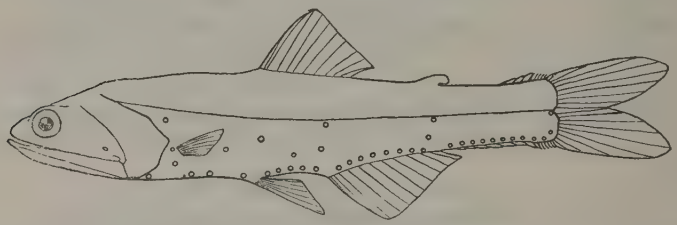

FIGURE 11.—LAMPANYCTUS REGALIS GILBERT

also by the slightly lower position of its *VLO*. The differentiation of *L. ritteri* in division *d* has been treated in the previously rendered key.

Known only from the coast of California.

LAMPANYCTUS REGALIS Gilbert, 1892

Myctophum regale GILBERT, 1892.
Nannobrachium regale JORDAN and EVERMANN, 1896.
Myctophum (*Lampanyctus*) *regale* BRAUER, 1906.
Lampanyctus regalis GILBERT, 1915; PARR, 1928.

Material investigated. Type specimen No. 44289, U.S.N.M. Coast of California.

The original diagnosis (Gilbert, 1892, p. 7) has been supplemented by a detailed, and in general very accurate description rendered by Gilbert, 1915 (p. 316), but no illustration has been previously published.

As in the case of *L. ritteri*, the "somewhat larger luminous body . . . on lower posterior portion of cheeks" is so minute that there is a considerable probability of its being unrecognizable in small

specimens. 5 *VO* were found to be present instead of only 4 as described by Gilbert.[23]

Correctly defined in the previously rendered key.

Recorded only from the coast of California.

LAMPANYCTUS ALATUS Goode and Bean

Lampanyctus alatus GOODE and BEAN, 1895; JORDAN and EVERMANN, 1896. (Not Taaning, 1918,[24] and Breder, 1927.[25])

Myctophun (*Lampanyctus*) *alatum* BRAUER, 1906; ZUGMAYER, 1911; BARNARD, 1925.

Lampanyctus pseudoalatus TAANING, 1928, PARR, 1928.

Material investigated. Type sample No. 43769, U.S.N.M. Two specimens from the Gulf of Mexico.

An inspection of the above two type specimens reveals the identity of *Lampanyctus alatus* Goode and Bean with *L. pseudoalatus* Taaning, 1928, by the presence of a luminous scale (or a pair of luminous scales) in the adipose dorsal fin as well as by the comparatively high fin counts already previously recorded by Goode and Bean (1895, p. 79). [D 13, A 17–18, as compared with D 11–13, A 14–15 in *L. pusillus* Johnson (according to Taaning, 1928, p. 66).] The *VLO*'s have, on the other hand, become completely lost in both specimens, and the organ indicated in Goode and Bean's figure (loc. cit., fig. 92, pl. 24) in what might be an approximately normal position for a *VLO*, evidently gives a somewhat misplaced representation of the elevated fourth *PO*, which is well preserved in the specimens, but otherwise not shown in the illustration. This error in the original drawing certainly has given ample justification for the introduction of Taaning's new species *L. pseudoalatus*, which, however, must now be included among the synonyms of *L. alatus* Goode and Bean, as above made out. The existing confusion in the literature makes a complete redescription and a new figure of the species desirable.

Measurements of type sample of Lampanyctus alatus Goode and Bean, 1895 No. 43769 U.S.N.M.

[In per cent of the total length without caudal fin]

Total length without caudal fin in mm	47	44
Length of head	28	27
Diameter of eyes	6. 5	6. 8
Length of lower jaw	21	22
Greatest height	17	17
Height of caudal peduncle	8. 5	9
Snout to D	47	47
Snout to V	42	41
Snout to A	57	58

[23] The author is indebted to Messrs. B. A. Bean and E. D. Reid, of the division of fishes, United States National Museum, for kindly verifying the correctness of this observation.

[24] *L. pusillus* Johnson, according to later identification by Taaning (1928, p. 66).

[25] *Lampanyctus warmingi* Lütken, *Myctophum macrochir* Günther, and *Myctophum imitator* (Parr) [=*M. suborbitale* Gilbert].

Pectoral fins long, reaching to or beyond the origin of anal fin.

Minute luminous organs scattered over the head and body. A moderate, but conspicuous, photophore in the middle of each cheek. *PLO* close to the lateral line. 2 *PVO* in a slightly oblique series, the upper a little anterior to the lower. 5 *PO*, the fourth elevated approximately to the level of the lower end of the base of pectoral fin. *VLO* lost in the types, close to the lateral line according to Brauer 1906 and Taaning 1928. 4 *VO*, all on the same level. *SAO* angulate. Anterior SAO above the interspace between second and third *VO*, slightly but distinctly higher than second *SAO*. Second *SAO* well behind vertical from the last *VO*, which is situated entirely in advance of the line through second and third *SAO*. Upper (third) *SAO* at the lateral line. Second *SAO* approximately equidistant from third *SAO* and fourth *VO*. *AO* 7+6, none elevated. The

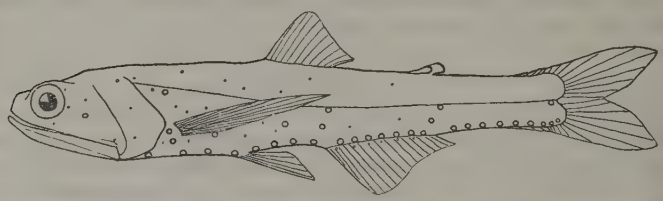

FIGURE 12.—LAMPANYCTUS ALATUS GOODE AND BEAN. ONLY A FEW OF THE MINUTE ACCESSORY PHOTOPHORES HAVE BEEN DRAWN TO SHOW THEIR RELATIVE PROPORTIONS

postero-anal series begins well behind the base of anal and is posteriorly confluent with the 4 *Prc*, which are differentiable, however, by their smaller size and the shorter intervals between the first and second and between the second and third organs. Interspace between third and fourth *Prc* greatly increased. Fourth *Prc* immediately below the lateral line, somewhat in advance of the vertical from the third *Prc*. 2 *Pol*, in a straight, oblique series with the last antero-anal photophore, and with the upper organ immediately below the lateral line, well behind the vertical from the lower.

Four supra- and four infra-caudal luminous scales, the latter occupying a somewhat greater portion (about two-fifths) of the length of the free caudal peduncle than do the former. A luminous scale, or pair of scales in the adipose fin.

The species has been recorded from the Atlantic and Indian oceans.

LAMPANYCTUS CROCODILUS Risso, 1810

Gastropelecus crocodilus Risso, 1810.
Lampanyctus crocodilus Parr, 1928 (with earlier synonymy).
Lampanyctus gemmifer Goode and Bean, 1895; Jordan and Evermann, 1896. (*Not* Brauer, 1906; Zugmayer, 1911; Pappenheim, 1914; Taaning, 1928; and Parr, 1928.)

Material investigated. Type specimen of *Lampanyctus gemmifer*, Goode and Bean, No. 35604, U. S. N. M. Western Atlantic.

An inspection of the above type specimen reveals the perfect identity of Goode and Bean's species with the *L. crocodilus* already described by Risso in 1910, as clearly shown on the accompanying diagram. Three photophores are found on each cheek, in the arrangement typical of *L. crocodilus* and a luminous scale is present in the adipose fin.

Further discussion of the characters of the specimen is unnecessary with the very adequate descriptions of *L. crocodilus* already

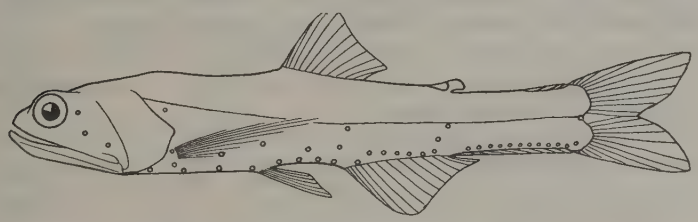

Figure 13.—Lampanyctus crocodilus Risso, drawn from the type specimen of Lampanyctus gemmifer Goode and Bean

available in the literature (Brauer, Holt and Byrne, Taaning; see synonymy in Parr, 1928, p. 90).

With *L. gemmifer* thus eliminated as a separate species, however, it now becomes necessary to designate a new name for the truly distinct taxonomic form currently identified with Goode and Bean's nominal species.

LAMPANYCTUS TAANINGI, new species

Myctophum (*Lampanyctus*) *gemmifer* Brauer, 1906; Zugmayer, 1911; Pappenheim, 1914.
Lampanyctus gemmifer Taaning, 1928; Parr, 1928.

Specimen No. 2301, of the Bingham Oceanographic Collection, "*Pawnee*" Station 25, 1927, Exuma Sound, Bahamas, has been designated as the type. A paratype from the same haul has been deposited in the United States National Museum.

The species is easily distinguished from the above *L. crocodilus* Risso by the absence of luminous scales in the adipose fin and by the presence of only two photophores on each cheek.

As a very adequate and generally accurate figure and description of the species has already previously been rendered by Brauer 1906 (p. 246), we can here confine ourselves to a few notes on minor differences observed in the above recorded type and paratype.

The upper organ on the cheeks is in both specimens slightly, but distinctly nearer to the posterior margin of the orbit than to the praeopercular margin. The posterior margin of the lower *Pol* barely touches the line through the centers of the upper *Pol* and the last *AO* anterior, these three organs thus not forming an entirely straight series, but only nearly so. The type specimen has 6+7 *AO*, well separated from the four *Prc*. In the paratype 6+8 *AO* are found, the *AO* posteriores being confluent with the 4 *Prc*. The latter organs are, however, also in this case readily distinguishable from the *AO* posteriores by their slightly smaller size and closer arrangement. Third *Prc* only very slightly, barely noticeably, below the line from the second to the fourth *Prc*. Interspace between third and fourth *Prc* increased. The above recorded numbers of *AO* differ from those given by Brauer on account of the fact that only the two most posterior *Prc* as here understood were counted as praecaudals by the said author.

Recorded only from the Atlantic.

Named in honor of Å. Vedel Taaning in recognition of his valuable contributions to our knowledge of the biology and taxonomy of the Myctophinae.

DIAPHUS UROLAMPUS Gilbert and Cramer, 1897

Myctophum (*Diaphus*) *urolampus* Brauer, 1906.
Diaphus urolampus Jordan and Jordan, 1922; Parr, 1928.

Material investigated. Type specimens No. 47709, U.S.N.M. (3 specimens).

An inspection of the type-specimens did not serve to confirm the statement rendered by Gilbert (1908, p. 227, under discussion of *D. agassizi*), that the upper antorbitals are "apparently no longer functional," but on the contrary revealed the organs in question as being, at least macroscopically, apparently perfectly equivalent with the presumably functional upper antorbitals of such species as *D. dumerili* Bleeker, *D. hypolucens* Parr and others. Each of the upper antorbitals in *D. urolampus* has a small, but very distinct body of whitish, supposedly luminous tissue imbedded in densely pigmented black tissues. There are no lower antorbitals, and no supra- or suborbital organs. The species thus properly belongs in division II A 1 in the key previously rendered by the author (Parr, 1928,

p. 115), together with *D. agassizi* Gilbert 1908,[26] but not in a separate Division I.

D. urolampus is distinct from *D. dumerili* Bleeker, in which species it was tentatively included by Weber and Beaufort, 1913,[27] in the absence of a suborbital organ, in the elevation of the first *AO* anterior and in having the *VLO* situated close to the lateral line, not at a considerable distance below it. The latter feature also distinguishes *D. urolampus* from *D. agassizi* Gilbert, with which species it is otherwise very closely related. These differences have been further made out in the following supplementary key to the species of the genus *Diaphus*, which have only one small antorbital organ on each side, entirely above the nostril (Division II A in the previously rendered key, Parr 1928, p. 115).

I. Upper *SAO* and *Pol* close to or in contact with the lateral line.
  A. *VLO* in contact with or very close to the lateral line. First *AO* anterior elevated.
    D. urolampus Gilbert and Cramer.
  B. *VLO* well below the lateral line.
    D. dumerili Bleeker.
    D. agassizi Gilbert.
    (See Parr 1928, p. 115.)

II. Upper *SAO* and *Pol* well below the lateral line.
  D. gemellari Cocco.
  D. dofleini Zugmayer.
  D. nipponensis Gilbert.
  (See Parr 1928, pp. 115–116.)

Measurements of Diaphus Urolampus Gilbert and Cramer, 1897. Type specimens No. 47709 U.S.N.M.

[In per cent of total length without caudal fin]

Total length without caudal fin in mm	90	79	75
Length of head	29	29	30
Greatest height	20	19	20
Length of lower jaw	22	22	23
Diameter of eye	7.8	8.2	8.0
Distance snout to D	42	41	42
Distance snout to V	43	42	44
Distance snout to A	64	63	65

Upper antorbital very small, but distinct and normally developed. No lower antorbital, no supra or suborbital organs. *PLO* much closer to the lateral line than to the base of pectoral fin. *PVO* in a straight series with the anterior *PO*. Fourth *PO* elevated to some-

[26] *D. dumerili* Bleeker, 1856, has for practical purposes been included both in this division and in Division IV, where it properly belongs, as the suborbital organ, though always present, is often difficult to make out on account of its minuteness.

[27] This view has been accepted by Fowler, 1928 (p. 68).

what above the level of the upper *PVO*.[28] *VLO* in contact with the lateral line. 5 *VO*. 3 *SAO*, the lower slightly in advance of the fifth *VO* and of the line through second and third *SAO*. Second *SAO* much closer to the lower *SAO* than to the upper, which is in contact with the lateral line. First *AO* anterior sharply elevated, last *AO* anterior also very conspicuously above the level of the rest of the series. *AO* 7+6. 4 *Prc*, the last organ slightly below the end of the lateral line.

The original illustration (Gilbert and Cramer, 1897, pl. 38, fig. 1) being inadequate for showing the accurate arrangement of the photophores, the accompanying diagram (fig. 14) was prepared from the type specimen.

Two specimens have a very conspicuous median dorsal luminous area on the caudal peduncle, occupying the greater part of the distance between the caudal and the adipose dorsal fin.

Known only from Hawaiian waters.

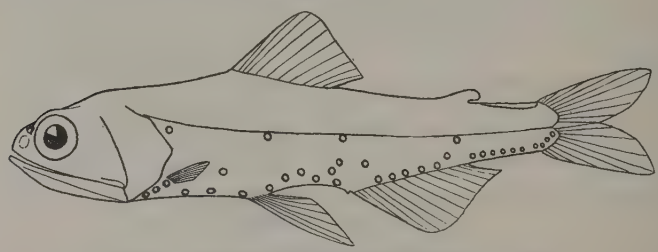

FIGURE 14.—DIAPHUS UROLAMPUS GILBERT AND CRAMER

DIAPHUS AGASSIZI Gilbert, 1908

Diaphus agassizii GILBERT, 1908 and 1913; PARR, 1928; FOWLER, 1928.
Myctophum (*Diaphus*) *lacerta* (part)? BRAUER, 1906.

Material investigated. Type specimen No. 75764, U.S.N.M. From the Marquesas Islands.

The original description and figure (Gilbert, 1908, p. 226 and pl. 2), together with the remarks upon some of its features subsequently added by the same author (Gilbert, 1913, p. 85) give a very adequate and accurate conception of the characters of this species, making further comment unnecessary.

The species is distinct from *D. dumerili* Bleeker by the absence of a suborbital organ and by the elevation of the first *AO* anterior, and from *D. urolampus* Gilbert and Cramer by having the *VLO* situated only "very slightly nearer lateral line than base of ventrals."

Properly defined in the previously rendered key (Parr, 1928, Division II A 1, p. 115).

Known from the Marquesas Islands and from Japan.

[28] This character can not be considered very reliable except in perfect specimens.

DIAPHUS DUMERILI Bleeker, 1856

Scopelus dumerili BLEEKER, 1856.
Lampanyctus lacerta GOODE and BEAN, 1895.
Diaphus nocturnus (Poey) GILBERT, 1906.
Diaphus dumerili PARR, 1928 (with earlier synonymy); FOWLER, 1928.

Material investigated. Type specimen of *Lampanyctus lacerta* Goode and Bean, 1895, No. 43778.

An inspection of the type specimen of Goode and Bean's *Lampanyctus lacerta* can only serve to confirm in every detail its perfect identity with the species now designated as *Diaphus dumerili* Bleeker according to Weber and Beaufort, 1913. (See Parr 1928, p. 126.)

D. dumerili differs from *D. agassizi* Gilbert and *D. urolampus* Gilbert and Cramer in the possession of a minute suborbital organ, which is always present, but sometimes difficult to make out. *D. dumerili* has its *VLO* situated approximately midway between the

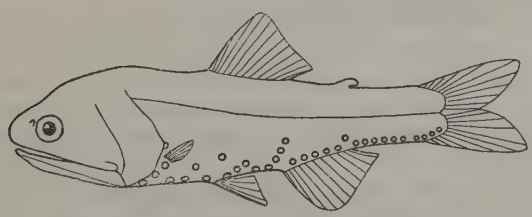

FIGURE 15.—DIAPHUS NIPPONENSIS GILBERT

lateral line and the base of ventral fin or, more frequently, somewhat above this point.[29]

The species has been very adequately described and figured by Gilbert, 1906 (p. 255 and pl. 1) under the name of "*Diaphus nocturnus* Poey," and has been further discussed in various details by Weber and Beaufort, 1913, and by Parr, 1928.

Recorded from the Atlantic and from East-Indian waters.

Taaning, 1928 (p. 58) designates the Atlantic material of *D. dumerili* as *D. dumerili nocturnus*, without discussing the differences by which this subspecies can be distinguished from the East Indian form.

DIAPHUS NIPPONENSIS Gilbert, 1913

Material investigated. Type specimen No. 74467, U.S.N.M.

This species has been adequately described by Gilbert, 1913 (p. 86), and correctly defined in the previously rendered key.

[29] This feature is not always quite reliable for the differentiation of groups 1 and 2, Division II A in the key previously given by the author (Parr, 1928, p. 115) and the main significance should therefore in this case be attached to the positions of the upper *SAO* and the *Pol* as described in the same key.

A diagram of the type specimen is rendered in the accompanying Figure 15, the species not having been previously illustrated.

Known only from Japan.

DIAPHUS GLANDULIFER Gilbert, 1913

Material investigated. Type specimen No. 74472, U.S.N.M.

Accurately and adequately described and figured by Gilbert, 1913 (p. 90 and pl. 11, fig. 2). Correctly defined in the previously rendered key.

Known only from Japan.

DIAPHUS RAFINESQUEI Cocco, 1838

Nyctophus rafinesquei Cocco, 1838.
Diaphus rafinesquei Parr, 1928 (with full synonymy).
Diaphus theta Eigenmann and Eigenmann, 1891; Goode and Bean, 1895; Jordan and Evermann, 1896; Brauer, 1906.
Myctophum protoculus Gilbert, 1891.
Diaphus nanus Gilbert, 1908 and 1913.

Material investigated. Type lot of *Diaphus theta* Eigenmann and Eigenmann, 1891, No. 41914, U.S.N.M. (2 specimens). Type specimen of *Myctophum protoculus* Gilbert, 1891, No. 44290, U.S.N.M. Type specimen of *Diaphus nanus* Gilbert, 1908, No. 75765, U.S.N.M.

The claim of *D. theta* Eigenmann and Eigenmann to specific distinctness from *D. rafinesquei* Cocco has heretofore been mainly or entirely based upon the alleged smaller size of the eyes in the type of the former nominal species. An examination of the type specimens, however, served to show that no such difference seems to exist, the eyes of *D. theta* being quite as large as those of the normal *D. rafinesquei*, with a diameter equalling more than one-third of the length of the head or 10 to 12 per cent of the total length without caudal fin. *D. theta* is therefore herewith included among the synonyms of *D. rafinesquei*.

The identity of *Myctophum protoculus* Gilbert with *D. theta* Eigenmann and Eigenmann has already been realized by the author of the former species (footnote by Gilbert in Jordan and Evermann 1896, p. 564), and could only be further confirmed by an inspection of the type.

The lack of taxonomic differences between the descriptions of *Diaphus nanus* rendered by Gilbert, 1908 and 1918, and the current descriptions of *D. rafinesquei* Cocco has already previously prompted the author to include the former name among the synonyms of the latter species (see Parr, 1928, pp. 131 and 135). This opinion stands unaltered after examination of the type specimen of *D. nanus*.

Although the three above-considered types have thus all been included in the older species *D. rafinesquei* Cocco, 1838, it is nevertheless desirable to give a more detailed account of the investigated specimens for the purpose of deciding their possible racial relationships and the taxonomic priority of their names, in case it should prove possible to subdivide the species, as here understood, into statistical groups of subordinate rank along the lines of taxonomic differentiation followed by Taaning, 1918 and 1928, by the introduction of his two new species, *D. holti* and *D. mollis*. The type specimens considered in the present paper, however, only seem to give further confirmation of the opinion already expressed by the author (Parr, 1928, pp. 131–135) that such subdivision can only be applied to comparatively restricted geographic regions, for the purpose of defining ecological races, but does not enable us to make taxonomic differentiations of general validity and therefore can not serve as a basis for the definition of separate species.

Table of measurements

[In per cent of total length without caudal fin]

Specimen No.	44290	41914		75765
Type of	*M. protoculus*	*D. theta*		*D. nanus*
Total length without caudal fin in mm	61	45	30	13
Length of head	28	27	32	33
Diameter of eye	9	10	12	12
Length of lower jaw	20	21	23	20
Length of maxillary	19	21	23	19
Greatest height	21	22	23	23
Snout to D	46	74	50	50
Snout to V	44	44	45	46
Snout to A	66	65	65	62

The arrangement of the photophores in the three types is shown in the accompanying diagram.

In *D.* "*theta*" the upper *SAO* and the *Pol* are much nearer to the lateral line than to the ventral series of photophores, while the *VLO* is considerably closer to the base of ventral fin than to the lateral line, and the *PLO* is situated about or slightly below midway between the latter and the upper end of the base of pectoral fin. The *SAO* are placed in an approximately straight and nearly equally spaced series, and the first anterior *AO* is not elevated. *AO* 5+6. *Prc* well separated from the posterior *AO*. According to the definitions first given by Taaning (1918) *D.* "*theta*" should thus agree with *D. holti* Taaning in the positions of the anterior *AO* and of the *VLO*, differing from *D. rafinesquei* Cocco in both of these respects.

According to the later synopsis by the same author (Taaning, 1928), however, we find the type of *D.* "*theta*" differing very conspicuously from *D. holti* by the higher positions of the *Pol* and the upper *SAO* in the former. It further differs from Taaning's new species *D. mollis* (Taaning, 1928) by having the *SAO* in a nearly straight series, and should thus, according to the above-mentioned

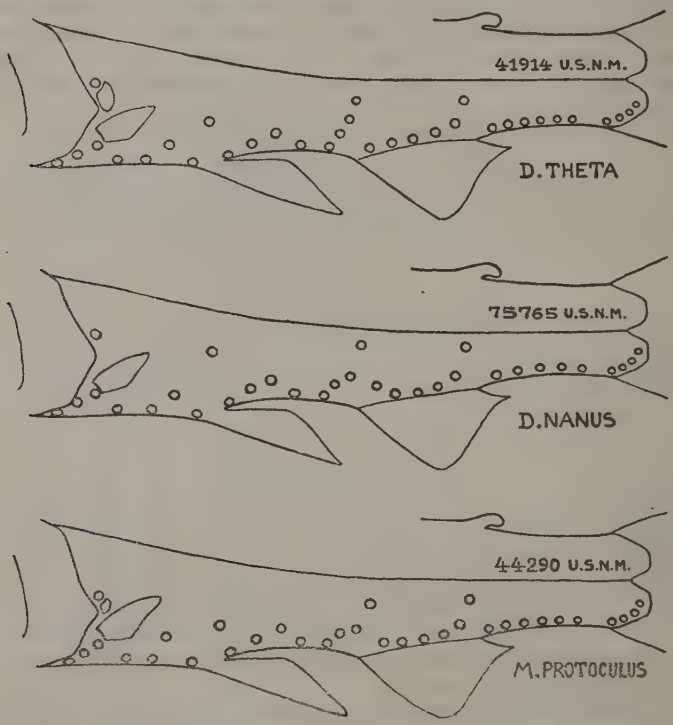

FIGURE 16.—DIAPHUS RAFINESQUEI COCCO. REPRESENTED BY THE TYPE SPECIMENS OF D. THETA EIGENMANN AND EIGENMANN, D. PROTOCULUS GILBERT, AND D. NANUS GILBERT

synopsis, be identifiable with *D. rafinesquei*, from which it has already been shown to be taxonomically different according to Taaning's definitions of 1918. It may further be mentioned that *D.* "*theta*" seems to differ from all of the above-discussed species in having 6 posterior *AO*, while the maximum recorded by Taaning for any of the forms described by him is 5 *AO* post. In most of the respects above considered *D.* "*theta*" agrees with specimen No. 2147

of the Bingham Oceanographic Collection (see Parr, 1928, pp. 131–135, and fig. 25), which differs, however, in having the *PLO* much nearer to the pectoral fin than to the lateral line, and in having the *Prc* confluent with the posterior *AO*. Specimen No. 2146 B. O. C. also shows 6 photophores in the postero-anal series and further approaches *D.* "*theta*" in having a somewhat, though not very conspicuously, increased interspace between the last *AO* posterior and the first *Prc*,[30] but also differs in the lower positions of its *PLO*, upper *SAO*, and *Pol*.[31] The discordance between the various specimens with 6 posterior *AO*, and the consequent impossibility of basing a recognition of a separate species or subspecies "*theta*" on this feature, is further increased when we also include the type specimen of *D.* "*protoculus*" in our considerations.

The type of *D.* "*protoculus*" agrees with the type of *D.* "*theta*" in having 6 posterior *AO*, well separated from the *Prc*, and in having the *VLO* nearer to the base of ventral fin than to the lateral line. It differs from *D.* "*theta*," however, in having the first anterior *AO* slightly but distinctly elevated (see the diagram), in having the *PLO*, *VLO*,[32] upper *SAO*, and the *Pol* inserted conspicuously lower than in the type of the said form, and in having the *SAO* arranged in an obtuse angle with the interspace between the second and third organ much greater than that between the first and second. According to Taaning's synopsis this species should thus seem related to *D. mollis* Taaning, but the difference from the other specimens of the *rafinesquei*-type, investigated by the author, with regard to the length of the maxillary, which is used by Taaning as a diagnostic character, is altogether too slight to be considered taxonomically significant; and it is, unfortunately, impossible to give any statements concerning the size of the luminous scale at *PLO* or the accurate positions of the suborbital organs on account of the shrinkage of

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[30] The discontinuity of the two series is shown as slightly too distinct in the diagrammatic illustration of this specimen (Parr, 1928, fig. 25), while it is very distinct and conspicuous in the type of *D.* "*theta.*"

[31] The previous statement (Parr, 1928, p. 132) that specimen No. 2146, B. O. C., agrees "fairly well" with the definition of *D. holti* Taaning in having the upper *SAO* and *Pol* "about equidistant from the lateral line and the ventral row of photophores" is based upon the vertical distance above the horizontal level of the next following organ in the ventral series (first anterior *AO* and first posterior *AO*, respectively), and is merely of relative and approximate value, being absolutely accurate only of the *Pol*, while the upper *SAO*, though distinctly lower than in specimen No. 2147, B. O. C., and much lower than in specimen No. 2148, B. O. C., is still somewhat above the point of equidistance between the two morphological levels referred to.

[32] The specimens are too small and too old to give accurate measurements, but in spite of the fact that the *VLO* is also in *D.* "*theta*" considerably closer to the ventral fins than to the lateral line, the *VLO* is still conspicuously lower in the type of *D.* "*protoculus*," as will appear from an inspection of the accompanying diagram. The same also holds good of the *PLO*, which in *D.* "*theta*" is only slightly below midway between the base of pectoral fin and the lateral line, while it is much closer to the former in *D.* "*protoculus.*"

the specimen. *D.* "*protoculus*" does in all the above considered respects, particularly with regard to the positions of upper *SAO* and *Pol*, agree very well with specimen No. 2146 B. O. C., differing however, by the arrangement of the *SAO*, which in the latter specimen are found in a gently curved, although somewhat unequally spaced series continuous with the last *VO*, not in an obtuse angle as in the type of *D.* "*protoculus*".

The type specimen of *D.* "*nanus*" differs from those of *D.* "*theta*" and "*protoculus*" in having only 5 + 5 *AO* (not 6 *AO* posteriores). According to Gilbert 1908, p. 225, the *VLO* should be "half way between lateral line and the base of ventrals"; in the author's opinion, however, they now seem distinctly closer to the lateral line. *PLO* somewhat nearer to the pectoral base than to the lateral line. Upper *SAO* and *Pol* much nearer to lateral line than to the ventral series of photophores. *SAO* in an obtuse angle. First *AO* anterior elevated nearly to the level of the second *SAO*. *Prc* well separated from the *AO* posteriores. In all these respects *D. nanus* should thus be perfectly concordant with *D. mollis* Taaning, as already suggested by Taaning when he introduced the latter species. As in the case of the specimens in the Bingham Oceanographic Collection, however, the length of the maxillaries does not show sufficient difference from the measurements of the other specimens such as for instance the type specimen of *D. protoculus* (see the table, p. 33) to make the form taxonomically recognizable as a separate species on the basis of this character.

On the basis of these observations on the type specimens of *D. theta*, *D. protoculus*, and *D nanus* the author can only feel confirmed in the opinion that the subdivision of the *rafinesquei*-like forms into entirely separate species according to the definitions rendered by Taaning (1918 and 1928) is absolutely impracticable, although such subdivision may possibly be of great value for differentiating ecological races or local subspecific forms within restricted oceanographical areas.

The accurate dimensions of the luminous scale at *PLO* and the exact natural position of the posterior suborbital organ can not now be made out with reliability in any of the above considered type specimens.

KEY TO THE SPECIES OF DIAPHUS WITH TWO SEPARATE ANTORBITAL ORGANS (ONE UPPER AND ONE LOWER) AND ONE DISTINCT SUPRAORBITAL ORGAN ON EACH SIDE

The discovery that a distinct and very well developed supraorbital organ, in addition to the upper antorbital, is present on each side not only in *D. adenomus* Gilbert, 1908, and *D. anteorbitalis* Gilbert, 1913,[33]

[33] See Parr, 1928, p. 119, key to the genus *Diaphus*, Division VI.

as already made out in the original descriptions of these species, but also in *D. chrysorhynchus*[34] Gilbert and Cramer, 1897, and *D. watasei*,[35] Jordan and Starks, 1904, makes a new key to this group of the genus *Diaphus* desirable.

I. Supraorbital organ short, triangular, entirely in advance of the vertical from the center of the eye. Upper antorbital moderate or rather large.

A. *PLO* much nearer to the lateral line than to the base of pectoral fin. Head comparatively large, its length equaling 29–31 per cent of the total length without caudal fin. Diameter of eyes 8.1–8.7 per cent of the same measurement, or about 3.4–3.6 in the length of the head. Upper *SAO* and *Pol* close below the lateral line. AO 6+5–6.

D. chrysorhynchus Gilbert and Cramer, 1897.

B. *PLO* much nearer to the base of pectoral fin than to the lateral line. Head smaller, its length only equal to about 26 per cent of the total length without caudal fin. Diameter of eyes about 6.5 per cent of the same measurement, or about 4 in the length of the head. Upper *SAO* and *Pol* more than 2 diameters below the lateral line. AO 7+5.

D. watasei Jordan and Starks, 1904.

II. Supraorbital long and slender, extending to or beyond the vertical from the center of the eye, "in the form of a narrow streak." Upper antorbital small.

A. *PLO* only very slightly below midway between the lateral line and the base of pectoral fin, its distance above the latter equaling about ⅞ of its distance below the former. Eyes about 3.8–4 in head.

D. anteorbitalis Gilbert, 1913.

B. *PLO* nearly twice as far from the lateral line as from the base of pectoral fin, the ratio between the two distances being as 16:9. Eye about 4⅔–5 in head.

D. adenomus Gilbert, 1905.

DIAPHUS CHRYSORHYNCHUS Gilbert and Cramer, 1897

Diaphus chrysorhynchus JORDAN and JORDAN, 1922, PARR, 1928, FOWLER, 1928.
Myctophum (*Diaphus*) *chrysorhynchus* BRAUER, 1906.

Material investigated. Type sample No. 47710, U.S.N.M. (6 specimens).

The original definition and figure of this species (Gilbert and Cramer, 1897, p. 409 and pl. 38, fig. 3)[36] being in many respects inadequate for proper identification, it has been deemed advisable to render a full description and diagrammatic illustrations of the essential features observed on the type material.

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[34] See Parr, 1928, p. 120, key to the genus *Diaphus*, division 9.

[35] This species has in the previously rendered key (Parr, 1928, p. 122) been identified with *D. coeruleus* Klunzinger, according to the precedent set by Gilbert, 1913.

[36] In Gilbert and Cramer's report the figures 2 and 3 on plate 38 and the corresponding references in the text have, by misprint, become exchanged for each other, figure 2 actually representing *Myctophum fibulatum* and figure 3 *Diaphus chrysorhynchus*, while the legends and references have these species in the opposite arrangement on the plate.

Measurements of Diaphus chrysorhynchus Gilbert and Cramer

[In per cent of the total length without caudal fin]

Total length without caudal fin in mm	80	75	63
Length of head	29	31	30
Greatest height	21	21	21
Length of lower jaw	21	21	21
Diameter of eyes	8.1	8.7	8.7
Snout to D	41	43	42
Snout to A	61	65	63
Snout to V	41	44	42

The description of the supraorbital organ as "a triangular or heart-shaped portion of it (the "anteorbital gland") at the anterodorsal angle of the orbit" has proved inadequate for conveying to subsequent investigators the proper conception of the morphological status of the organ in question. This supraorbital organ is quite distinctly, although narrowly, separated from the upper antorbital by a dividing ridge running obliquely upwards and mesad in a transverse plane at the anterior end of the snout. The subraorbital thus occupies a shallow, more superior and lateral concavity of its own, while the concavity of the upper antorbital is entirely transverse and forwardly directed (compare the figs. 17 and 18). There is apparently no continuity between the luminous tissues of the upper antorbital and the supraorbital organs in any of the specimens, the very conspicuous dividing ridge appearing as a narrow, lack lustrous, black line between the highly lustrous, silvery tissues of the organs themselves. These features of the circumorbital organs in *D. chrysorhynchus* are strongly affirmative of the opinion already previously expressed by the author that the so-called upper antorbital of such forms as *D. effulgens* Goode and Bean, 1895, is not homologous with the upper antorbital organs of the other Myctophinae, but rather with the constricted supraorbital portion of the upper antorbital in *D. metopoclampus*, which is again undoubtedly homologous with the supraorbital of *D. chrysorhynchus*. A comparison between the accompanying diagram (fig. 16) and the illustration of the circumorbital organs in *D. effulgens* already previously rendered (Parr, 1928, fig. 30, no. 6, p. 140) makes this relationship quite obvious. The author therefore no longer feels any hesitation in regarding the circumorbital organs of Division IX in the key to the genus *Diaphus* (Parr, 1928, p. 120) as developed through the differentiation of a

FIGURE 17.—FRONTAL VIEW OF THE HEAD OF DIAPHUS CHRYSORHYNCHUS GILBERT AND CRAMER, SHOWING THE ANTORBITAL AND SUPRAORBITAL ORGANS

separate supraorbital organ followed by a complete fusion of the upper and lower antorbitals on each side. Division IX then differs from the group treated in the key on page 37 (Division VI, Parr, 1928) by this latter feature, while the upper and lower antorbitals in the latter group, now under consideration, always remain distinct from each other.

The upper antorbitals of *D. chrysorhynchus* are quite large and only narrowly separated from each other as shown in the figure 17. The lower antorbital has a long, narrow, posterior ventral extension along the lower margin of the eye, ending approximately at the vertical from the center of the pupil or even beyond this point.

PLO conspicuously nearer to the lateral line than to the base of pectoral fin. *PVO* in a straight series with the anterior *PO*. Fourth *PO* elevated approximately to the level of the upper *PVO*. *VLO* about midway between the lateral line and the base of ventral fin.

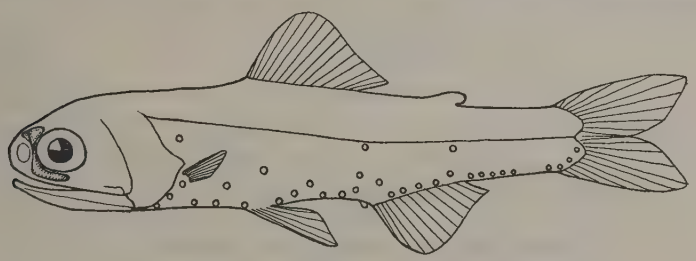

FIGURE 18.—DIAPHUS CHRYSORHYNCHUS GILBERT AND CRAMER

5 *VO*. SAO in a very steeply inclined, straight line, the continuation of which falls well behind the last *VO*. Interspace between first (lower) and second *SAO* much smaller than that between the second and the third (upper) *SAO*. 6+5 *AO* were counted in 11 cases, 6+6 *AO* in one case, each side being counted separately. First anterior *AO* elevated to a level about midway between that of the lower and that of the middle *SAO*. Last anterior *AO* also elevated. Upper *SAO* and *Pol* close to the lateral line. First posterior *AO* behind the base of anal fin. 4 *Prc*, equally spaced and curved, widely separated from the posterior *AO* and with the upper organ well below the end of the lateral line.

Known only from Hawaiian waters.

DIAPHUS WATASEI Jordan and Starks, 1904

Material investigated. Type specimen No. 51443, U.S.N.M.

This species was identified by Gilbert, 1913 (p. 95) with *D. coeruleus* Klunzinger 1871 and his example was followed by the present author in the previously rendered key to the genus *Diaphus* (Parr,

1928, p. 122). An inspection of the type specimen, however, tends to make this identity seem rather problematical on account of the fact that a well developed supraorbital organ, quite distinct from the moderate upper antorbital, apparently is to be found in the original *D. watasei.* A slight damage of the type specimen has made it impossible to make out the nature or presence of the upper organs of the circumorbital series on the left side of the head, but conditions on the right side [37] do, in the author's opinion, scarcely leave room for any doubt as to the existence of a distinct supraorbital organ, similar to the corresponding organ in *D. chrysorhynchus* in shape, nature, and position; but considerably smaller. Such supraorbital organs have not been described for *D. coeruleus*, and *D. watasei* must therefore, at least tentatively, be regarded as taxonomically distinct from the former species, although agreeing very closely in most other respects.

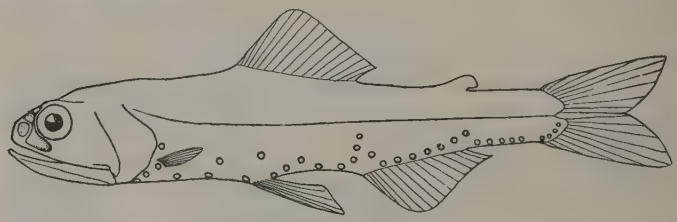

FIGURE 19.—DIAPHUS WATASEI JORDAN AND STARKS

The original illustration (Jordan and Starks, 1904, p. 581) being inadequate for showing the exact arrangement of the photophores and circumorbital organs, the accompanying diagram has been prepared from the type specimen.

PLO much nearer to the base of pectoral fin than to the lateral line. 5 *PO*. Fourth *PO* elevated approximately to the level of the upper *PVO*. *VLO* approximately midway between the lateral line and the base of ventral fin. 5 *VO*. *SAO* nearly equally spaced in a steeply inclined, straight line, the continuation of which passes well behind the last *VO*. *AO* 7+5. First anterior *AO* elevated to about midway between the levels of the first (lower) and second *SAO*. The posterior part of the antero-anal series is also gradually elevated toward the *Pol* with which the series is practically continuous. This elevation is noticeable from the fifth to the seventh antero-anal organs, inclusive (fig. 19). Upper *SAO* and *Pol* more than two of their own diameters removed from the lateral line. First postero-

[37] The organs in question are shown on the left side of the specimen in the accompanying diagram, fig. 18, to make the drawing harmonize with the other illustrations for the present report.

anal organ well behind the base of anal fin. 4 *Pre*, equally spaced in an even curve, well separated from the posterior *AO* and with the upper organ well below the end of the lateral line.

Total length without caudal fin 108 mm. Proportions in per cent of the total length without caudal fin: Length of head, 26. Diameter of eye, 6.5. Length of lower jaw, 19.5. Greatest height, 19.5. Distance from snout to dorsal fin, 42. Distance from snout to ventral fins, 44. Distance from snout to anal fin, 64.

The *VLO* of *D. coeruleus* is described as being closer to the bases of the ventral fins than to the lateral line, not about midway between as in the type of *D. watasei*, but with the possible exception of the arrangement of the photophores in the posterior part of the antero-anal series, this seems to be the only difference of any significance whatever which would appear to verify the taxonomic distinctness of the two species, above suggested as a possibility on the basis of the described observations on the circumorbital organs of *D. watasei*.

The type specimen of *D. watasei* was obtained in Sagami Bay, Japan.

DIAPHUS ANTEORBITALIS Gilbert, 1913

Diaphus anteorbitalis PARR, 1928.
Lamprossa anteorbitalis JORDAN and HUBBS, 1925.

Material investigated. Type specimen No. 74471, U.S.N.M.

This species has been very adequately and accurately described and figured by Gilbert, 1913 (p. 92 and pl. 12, fig. 1), and has been correctly defined in the previously rendered key.

The distance from the upper end of the base of pectoral fin to the PLO was found to be 3.5 mm., the distance from PLO to the lateral line canal being only 4 mm.

The type specimen apparently is a spent, the sex therefore being indeterminable without microsections.

Known only from Japan.

DIAPHUS ADENOMUS Gilbert, 1905

Diaphus adenomus JORDAN and JORDAN, 1922; PARR, 1928; FOWLER, 1928.

Material investigated. Type specimen No. 51533, U.S.N.M.

The author can not agree in the statement made by Gilbert, 1913, p. 92 (under discussion of *D. anteorbitalis*) that "in *D. adenomus*, both the superior preorbital and the extension between eye and nostril are lacking." An inspection of the type specimen on the contrary reveals the presence of a small, but quite distinct upper antorbital organ, which seems perfectly similar to the corresponding organ in *D. anteorbitalis*. The author was altogether quite incapable of dis-

covering any differences between the type specimens of these two species with regard to their circumorbital organs.

D. adenomus has otherwise been quite accurately and adequately described and figured by Gilbert, 1905 (p. 592 and pl. 68, fig. 1), and correctly defined in the previously rendered key.

The distance from the upper end of the base of pectoral fin to the PLO was found to be 4.5 mm., the distance from PLO to the lateral line canal being 8 mm.

The type specimen is a female.

The statement rendered by Fowler, 1928 (p. 68), that this species is "possibly not distinct from *D. coeruleus* (Klunzinger)" would equally well apply also to the rest of the four species mentioned in the key on page 37, if the presence or absence of a supraorbital organ should prove insignificant as a taxonomic character, or if such organ should appear to be present also in the true *D. coeruleus*. The former possibility seems rather remote, however, and the latter possibility is not indicated in either of the descriptions of *D. coeruleus* given by Klunzinger, 1871, and by Brauer, 1906.

It must on the other hand also be admitted that none of the four species would be satisfactorily differentiable from each other or from *D. coeruleus* on the basis of the photophores of the body alone, and the differences in proportions would also seem comparatively insignificant if not supplemented by differences in other respects.

D. adenomus is known only from Hawaiian waters.

DIAPHUS EFFULGENS Goode and Bean, 1895

Aethoprora effulgens Goode and Bean, 1895.
Diaphus effulgens Parr, 1928 (with full synonymy).

Material investigated. Type specimen No. 43770, U.S.N.M.

The original description of this species (Goode and Bean, 1985, p. 87) being in several aspects quite inadequate with regard to the distribution of the photophores, it has been deemed advisable to render a full account of the arrangement of these organs in the type specimen and a diagram has been prepared for convenience in interpreting the description.

The upper and lower antorbitals on each side have become fused to form a pair of very large luminous organs,[38] occupying practically

[38] See p. 38. To avoid confusion by the use of the key to the species the fused upper and lower antorbitals were in the previous treatise on these fishes designated simply as lower antorbitals, in accordance with the precedent set by Brauer, 1906, and generally followed in the later literature, although the author was already at that time strongly inclined to doubt the correctness of the homologization implied by the use of such terminology. (See Parr, 1928, p. 140.) The supraorbital organs were correspondingly designated as upper antorbitals. According to the new terminology, herewith introduced, the definition of Division IX (Parr, 1928, p. 120) should read: A small supraorbital organ on each side. Upper and lower antorbitals completely fused. The latter character then distinguishes this division from the division treated on p. 37 in the present report.

the entire snout anterior to the eyes and meeting each other at the median ethmoidal crest, as shown in the previously rendered diagram of the frontal view of this species. (Parr, 1928, fig. 30, 6, p. 140.) There is a small supraorbital organ between the upper posterior part of the fused antorbitals and the anterodorsal margin of the eye, in close contact with but quite distinct from the former organ. *PLO* nearer to the base of pectoral fin than to the lateral line. The two *PVO* in a straight series with the anterior *PO*. Fourth *PO* elevated approximately to the level of the upper *PVO*. *VLO* about midway between the lateral line and the base of ventral fin. Probably 5 *VO*, but the fourth is missing in the type specimen. Second and third *VO* elevated in a straight series with the first *VO*. 3 *SAO* in a very steep, practically straight line, the continuation of which passes well behind the last *VO*. Interspace between lower and middle *SAO* much smaller than that between the middle and upper organs. The anteroanals are arranged in an equally curved,

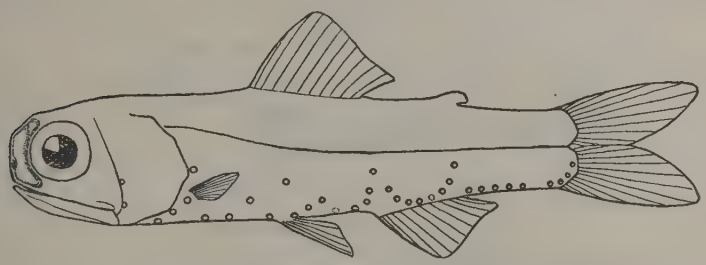

FIGURE 20.—DIAPHUS EFFULGENS GOODE AND BEAN

semicircular series which can be continued anteriorly to include the upper *SAO* and posteriorly to the *Pol.* 6 anteroanal organs are found in the type, but a somewhat increased interspace between the fourth and the fifth indicate the probability of another organ having been present in the undamaged specimen. *Pol* and upper *SAO* well below the lateral line (about two-thirds of their own diameters removed from the latter), their distances from the nearest *AO ant.* considerably larger than the interspaces between the anteroanal organs themselves. 5 posteroanals in a straight series beginning entirely behind the base of anal fin. 4 *Prc*, equally spaced and curved, with the upper organ well below the end of the lateral line.

Total length without caudal fin 118 mm. Proportions in per cent of the total length without caudal fin: Length of head 31. Diameter of eye 10.6. Length of lower jaw 19. Greatest height 23. Greatest vertical height of the snout anterior to the eyes 12. Distance from snout to ventral fin 47. Distance from snout to dorsal fin 43. Distance from snout to anal fin 65.

The great height and very characteristic outline of the steep, even slightly prominent snout has not been clearly shown in the original illustration of this species. (Goode and Bean, 1895, fig. 103, pl. 27.)

Type specimen from stomach of cod taken on Brown's bank in the Gulf of Maine.

Correctly defined in the previously rendered key.

DIAPHUS LUCIDUS Goode and Bean, 1895

Aethoprora lucida Goode and Bean, 1895.
Diaphus lucidus Parr, 1928 (with full snyonymy).

Material investigated. Type specimen No. 44084, U.S.N.M.

There is nothing to add to the discussion of this species already previously rendered by the author. (Parr, 1928, p. 141.)

Recorded only from tropical east American waters.

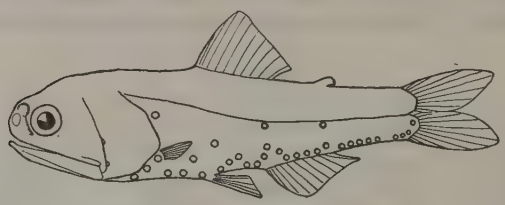

Figure 21.—Diaphus tanakae Gilbert

DIAPHUS TANAKAE Gilbert, 1913

Diaphus tanakae Parr, 1928.

Material investigated. Type specimen No. 74470, U.S.N.M.

An inspection of the type specimen brings out the fact that the antorbital organs, particularly the upper antorbitals, are proportionately so much larger in *D. tanakae* than in *D. problematicus* Parr (1928, p. 143) that the author feels satisfied that there can be no reason for maintaining any doubt about the distinctness of these two species. The upper antorbitals of *D. tanakae* are very large, extending mesad to a comparatively short distance from the median ethmoidal crest, each occupying about two-thirds or three-fourths of the distance between the latter and the anterior external margin of the orbit. The lower antorbitals extend to the level of the lower margins of the eyes.

Gilbert's description is in all other respects perfectly adequate and accurate, and the species has been properly defined in the previously rendered key.

No illustration of *D. tanakae* has heretofore been published.

Known only from Japan.

DIAPHUS SIGNATUS Gilbert, 1908

Diaphus signatus PARR, 1928, FOWLER, 1928.

Material investigated. Type specimen No. 75767, U.S.N.M.

Diaphus signatus has been adequately and accurately described and figured by Gilbert, 1908. (P. 228 and pl. 3.) Correctly defined in the previously rendered key.

Marquesas Islands.

LAMPADENA SPECULIGERA Goode and Bean, 1895

Lampadena speculigera JORDAN and EVERMANN, 1896; BRAUER, 1906; PARR, 1928.

Material investigated. Type specimen No. 43797, U.S.N.M.

The present condition of the type specimen unfortunately makes it quite impossible to determine any details of taxonomic significance, most of the photophores having become completely lost.

North Atlantic.

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